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ADUR & WORTHING
COUNCILS

Carbon Neutral Plan

Working towards the 2030 target

December 2019

Sustainable
Protecting our environment

Quality information

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Executive Summary

Background and Context

On July 9th 2019, the Joint Strategic Committee of Adur & Worthing Councils declared a Climate Emergency, and committed to working towards becoming carbon neutral by 2030.

As part of this commitment, the Councils resolved to develop a science- and evidence-based Carbon Neutral Plan that would identify the key actions and intervention measures required to set the Councils on the path to net zero carbon emissions. This work is intended to provide the Councils with an understanding of their own carbon emissions baseline and identify the steps that need to be taken to achieve the decarbonisation target by 2030.

Recommendations have been informed by carbon projections modelling, detailed energy audits, and stakeholder engagement workshops, to ensure that the Plan reflects the unique circumstances and priorities of Adur & Worthing Councils as they look towards the future.

This Plan is aligned to the Councils' strategic vision *Platforms for our Places* under *Platform 3: Tackling Climate Change and Supporting our Natural Environment*; and *SustainableAW*, the Councils' shared framework for sustainability. It also contributes to delivery against the Councils' UK100 Cities pledge to achieve 100% clean energy by 2050 across Adur & Worthing.

Establishing a baseline

In line with the Department of Business, Energy and Industrial Strategy (BEIS) '*Emissions Reduction Pledge 2020'* guidance,[1] for the purpose of greenhouse gas reporting, emissions are divided into three categories, referred to as Scope 1, 2 and 3. The table below provides a definition of these terms and summarises the data used in establishing Adur & Worthing Councils' baseline CO_2e emissions.

Category	Description	Data used in this analysis
Scope 1	Direct emissions from sources owned or controlled by the reporting organisation	Metered gas data (for buildings where the Councils pay the gas bills) Mileage for Council-owned vehicle fleet and pool cars, along with vehicle make/model and age
Scope 2	Indirect emissions from the generation of energy purchased by the reporting organisation	Metered electricity data (for buildings where the Councils pay the electricity bills) *Note that, where data was unavailable, industry standard benchmarks were used to estimate fuel consumption*
Scope 3	Indirect emissions that result from other activities that occur in the value chain of the reporting organisation, either upstream or downstream.	Metered water use data Records of business travel by the Councils' employees (cost data provided; mileage estimated from £/mi)

Based on this information – gas, electricity, and vehicle use in the year from April 2018-March 2019 – we estimate that the current annual Scope 1 and 2 emissions are approximately 2,908 tCO_2e per annum (p.a.). Scope 3 emissions from water consumption and business travel in non-Council owned vehicles (i.e. car mileage logged via essential or casual car user payments) each amount to approximately 33 tCO_2e p.a., or 66 tCO_2e p.a. in total. Scope 3 emissions from the Worthing Leisure Centre and Splashpoint (based on 2014/15 fuel consumption) accounts for a further 1,015 tCO_2e p.a.

[1] BEIS, *'Emissions Reduction Pledge 2020: Guidance for emissions reporting in the public and higher education sectors in England 2018-2020'* (April 2018). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/ file/745003/Guidance_note_for_voluntary_reporting-final.pdf

Note that there are additional Scope 3 emissions, such as those arising from business travel by public transport, car mileage not logged via essential or casual car user payments, emissions from waste or emissions from procurement that have not been quantified in this report due to insufficient data. In the future, Adur & Worthing Councils could consider a variety of additional data collection methods that could provide further visibility of these emissions.

Figures 1 and 2 below illustrate the relative contribution from different fuels, building use categories, external use categories (i.e. external lighting and CCTV) and vehicle types. (Note: emissions from the Leisure Centre and Splashpoint were estimated using 2014-15 data, which was the most complete information available.)

Figure 1. Emissions by source and fuel type (2018)

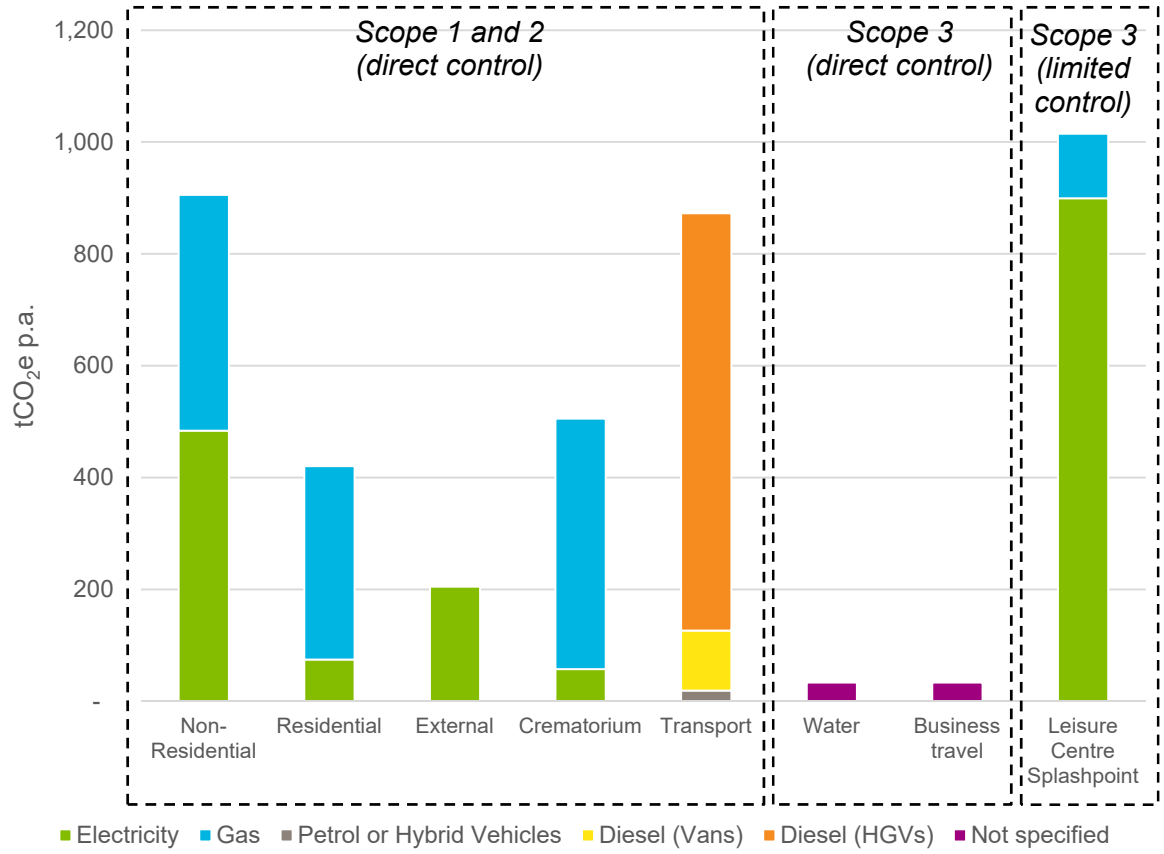
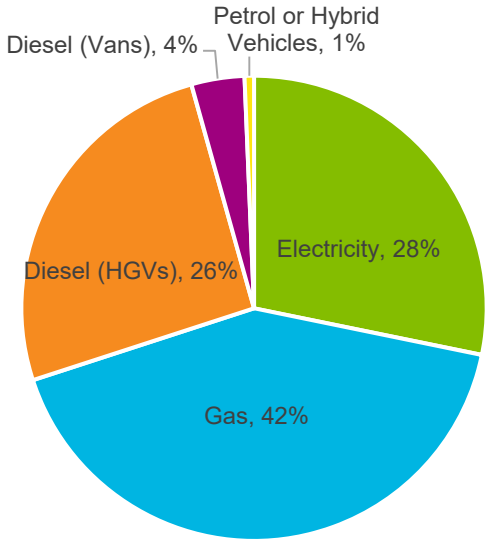


Figure 2. Scope 1 & 2 emissions by fuel type (2018-19)



Results show that gas and electricity use in buildings accounts for the majority of Scope 1 and 2 emissions (42% and 28%, respectively). The next biggest contributor is fuel use for HGVs (26%), while other vehicles such as cars and diesel vans make up around 5%. The crematorium also represents a significant source of CO_2e emissions, primarily due to the gas used for heat.

Based on available data going back to 2011/12, the Councils' Scope 1 and 2 emissions have decreased by approximately 20% overall and 23% since 2013/14. It is important to note that the annual emissions vary significantly over time, due to a variety of factors not assessed in detail in this report. These include factors such as weather and user behaviour, but a key sensitivity is linked to changes in the Councils' ownership or operation of buildings or provision of services. This report only considers properties both owned and operated by the Councils where they pay for the electricity and gas. As an example of the potential scale of impact this would have, if the Councils owned and operated the Worthing Leisure Centre and Splashpoint, their Scope 1 and 2 emissions would increase by around 32%.

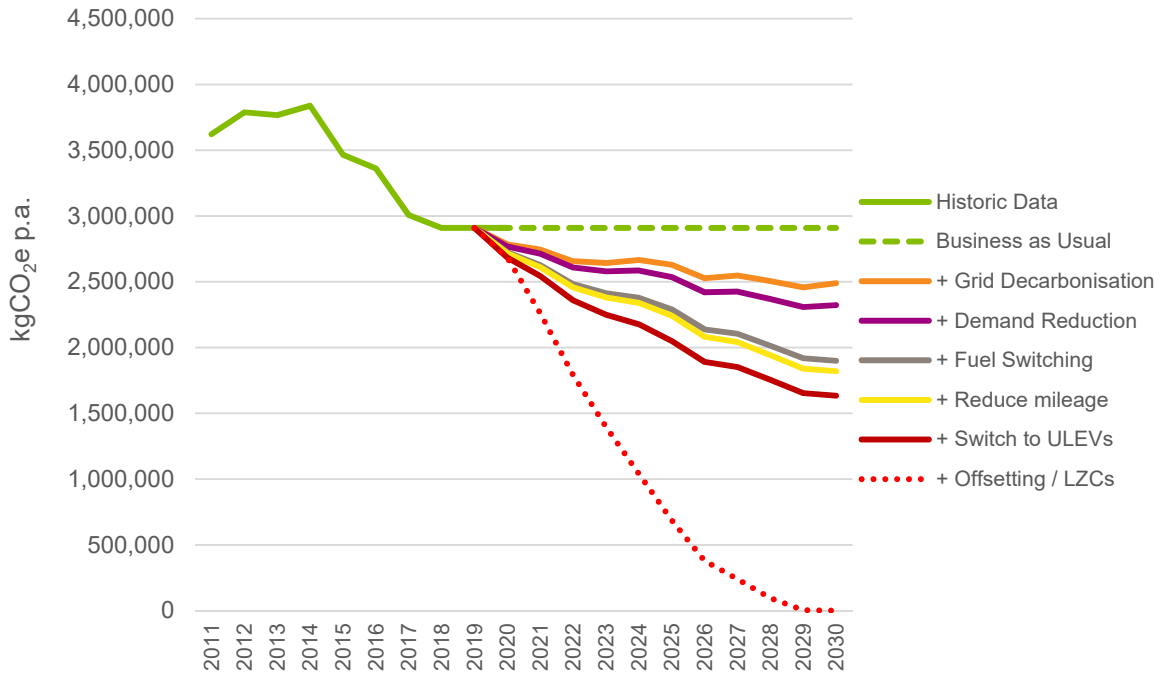
Routes to 2030

Carbon projection modelling has been carried out to assess the potential impact of a range of future trends that are expected to affect the Councils' emissions. This includes interventions that would be led by the Councils (e.g. switching to 100% electric vehicles), but also accounts for broader changes expected to take place on a primarily national level (e.g. decarbonisation of the national electricity grid). Other factors considered include energy demand reduction in existing buildings, switching from the use of gas-fired heating to electric systems, such as heat pumps, and reducing journey mileage, for instance, by planning vehicle routes differently, or taking measures to promote a shift towards walking, cycling, ridesharing and public transport.

It is important to note that these scenarios are ***not*** intended to predict actual fuel consumption or CO_2e emissions. Instead, they used to highlight key issues and support the identification of carbon reduction interventions to inform the actions and recommendations laid out in subsequent chapters of this Carbon Neutral Plan.

The cumulative impacts of these intervention measures are summarised in Figure 3 below.

Figure 3. Annual Scope 1 and 2 emissions: Routes to 2030



Note that 'Offsetting' could comprise a variety of measures, including investment in renewables (on or offsite) or carbon sequestration through land management (e.g. tree planting and woodland creation).

This analysis indicates that the most significant carbon reductions will result from switching towards the use of electric heating systems and electric vehicles – *provided that the national electricity grid undergoes significant decarbonisation*.

Demand reduction measures (energy efficiency and behavioural change in buildings, and reduced use of transportation) have less impact when considered on their own but are crucial prerequisites for successfully switching switch towards the use of electric heating and vehicles. For instance, energy efficiency improvements in buildings enable systems such as heat pumps to work at a higher level of efficiency. Similarly, a large-scale shift to the use of electric vehicles must be accompanied by a significant modal shift towards walking, cycling, ridesharing, and an increase in the use of public transport.

As buildings and vehicles switch away from the use of fossil fuels and towards electricity, it becomes increasingly important to ensure that electricity is supplied from renewable sources. This is important for several reasons, including reducing pressure on grid infrastructure, ensuring security of supply, and protecting consumers from rising electricity prices.

On the other hand, shifting towards the use of electricity means that the route towards becoming zero carbon increasingly depends on national grid decarbonisation. This leads to significant uncertainty when projecting carbon emissions and serves to reinforce the message that demand reduction and renewable energy generation should be high priorities for Adur & Worthing Councils.

The scenario testing demonstrated that, even with the most optimistic assessment of grid and transport decarbonisation and rapid uptake for energy efficiency measures, there will be significant residual CO_2e emissions that would require offsetting. Further work and consultation would be required to identify the most appropriate and cost-effective opportunities, but these could include:

- Investing in off-site renewable electricity generation. Note that, at present, the Councils purchase electricity that is 100% matched by wind and hydroelectric installations. Additional commitments would be required to offset emissions from all other fuel types.

- Carbon sequestration through land management, woodland creation, and tree planting. For context, as a rough estimate, offsetting the Council's current CO_2e emissions would require

conversion of around 800 hectares (almost 8 square kilometres) of low-grade agricultural land to sustainably managed woodland.[2] Offsetting the residual emissions after all measures are adopted (as shown in Figure 3 and assuming substantial grid decarbonisation) would still require around 460 hectares (4.6 square kilometres) of new woodland. As this is clearly not feasible, it shows the importance of mitigating emissions as far as possible, with this option used to address only the last remaining residual emissions.

Specific intervention opportunities

In order to identify specific opportunities for demand reduction measures in the Councils' own buildings, AECOM carried out building energy audits on a range of properties owned and operated by Adur & Worthing Councils.

The table below summarises the results of these audits, listing the potential intervention areas that could be considered, along with an estimate of the carbon savings that could be achieved. These estimates account for the energy efficiency improvement measures in addition to national electricity grid decarbonisation.

[2] Estimate based on an average of 3.56 tCO_2e / hectare of new woodland per year, based on nation-wide reporting by the UK Woodland Carbon Registry. See https://www.woodlandcarboncode.org.uk/uk-woodland-carbon-registry for more information.

Table 1. Results of building energy audits

Cells highlighted in green indicate that a measure is considered suitable for the specific building listed.

	HVAC & lighting plant									Fabric			Control systems					PV	Other			Results		
	Heat pump replacing boilers	*or New boilers*	Workshop infrared heating	Ventilation heat recovery	Overdoor air curtains	Plantroom insulation	Potential district heating	Variable speed pumps	Lighting upgrade	Glazing repair	Secondary glazing	Loft insulation	BMS temperature review	BMS timeclock review	BMS isntalled	Server room cooling level	Equipment on timer control	Car park PV	Non-gas cremators	Grey water heat recovery	Rainwater harvesting	Current C02 emissions per year in 2030 (tonnes)	Estimated max. carbon reduction by 2030	Est. potential C02 emissions per year in 2030 (tonnes)
Town Hall	■	■					■				■		■	■							■	187	55%	85
Portland House	■	■					■			■												52	54%	24
Sheltered housing	■	■				■									■							295	84%	46
MSCPs																		■				19	100%	0
Crematorium					■		■												■			473	41%	280
Shoreham Centre	■							■					■	■		■	■				■	60	57%	26
Commerce Way	■	■	■						■	■		■		■		■		■				52	77%	12
Assembly Hall	■	■					■		■		■		■	■	■						■	77	65%	27
Worthing Museum	■	■					■		■		■		■	■	■						■	46	74%	12
Worthing Leisure Centre	■			■														■		■	■	202	99%	3
																				Total		1,463	65%	515

In total, the above measures could potentially save up to 749 tCO_2e per annum (Scope 1 and 2 only), which is equivalent to roughly one quarter of the 2018/19 baseline. (However, note that not all of the buildings listed above are included within the Councils' Scope 1 and 2 baseline.) Broadly speaking, roof-mounted PV could also be installed on unshaded roofs of suitable orientation. Further reductions could potentially be achieved by introducing a district heat network within the Councils' Civic Quarter. This report provides an overview of the practicalities that would be involved in such a project, along with a discussion of the potentially significant benefits.

Priority areas and action plan

This work highlights that there is considerable uncertainty in the trajectory to 2030, and that that there will be significant challenges in reducing energy demands and offsetting any remaining CO_2e emissions. Adur & Worthing Councils will need to actively work towards enabling the following:

In buildings, it will be necessary to reduce heat and power demands through fabric efficiency improvements and behavioural change. In addition to investing in the existing building stock, this means ensuring that any future development achieves a high standard of energy efficiency in order to minimise any increase in fuel consumption. Long term, all buildings will need to switch from gas / fossil fuels to low and zero carbon heat sources.

Uptake of low and zero carbon (LZC) technologies and battery storage within the Councils' own stock will reduce reliance on fossil fuels, reduce pressure on existing utility infrastructure, improve security of supply, and mitigate against price fluctuations.

A transformation in the **transport** sector must take place, which would replace all existing vehicles with low and zero emission vehicles. In addition, it will be necessary to reduce vehicle use / mileage through behavioural change and modal shift.

A key challenge for Adur & Worthing Councils is the fact that much of the **emissions from vehicles are due to HGVs**, and due to technological factors, it is less certain that zero emission models will become commercially available by 2030. This suggests that careful route planning and other marginal efficiency improvements should be introduced to reduce HGV mileage as much as possible.

In order to **offset any remaining CO_2e emissions**, the Councils will need to explore additional measures, such as promoting carbon sequestration through sustainable woodland management or investing in large-scale renewable energy generation. It is important to note, however, that carbon offsetting is not enough to achieve the net zero target on its own – success relies on maximising demand reduction and renewable electricity generation as a high priority.

The detailed recommendations from the study are set out in an action plan which aims to support the Councils in delivering the intervention measures required to realise their carbon neutral ambition. The recommendations cover the following areas: General actions; Supporting grid decarbonisation; Demand reduction; Low carbon heating systems; Building integrated renewable energy generation and storage; Low carbon transport; Offsetting; and Scope 3 emissions. Consideration is given to measures that would directly impact CO_2e emissions from the Councils' own operations, as well as those that the Councils could indirectly influence, such as energy efficiency in leased or rented properties.

Conclusion

The results of this analysis show that the route towards becoming carbon neutral will require a strong level of ambition and commitment, backed up by significant interventions and investment across Adur & Worthing Councils' operations. Although the study shows that meeting the carbon neutral ambition will rely upon various factors outside of the Councils' control, such as the decarbonisation of the grid and availability of key technologies, the fundamental steps required to deliver the net-zero target are clear and, with strong leadership from the Councils, these can be set into action now.

1. Introduction and context

1.1 Adur & Worthing's Climate Emergency Declaration

On July 9th 2019, the Joint Strategic Committee of Adur & Worthing Councils (AWC) declared a Climate Emergency, and committed to working towards becoming carbon neutral by 2030.

As part of this commitment, the Councils resolved to develop a science- and evidence-based Carbon Neutral Plan that would identify the key actions and intervention measures required to set the Councils on the path to net zero carbon emissions within the next decade.

1.2 Purpose of this study

AECOM has been commissioned to support Adur & Worthing Councils in producing this Carbon Neutral Plan. This work is intended to provide the Councils with an understanding of their carbon emissions baseline and identify the steps that need to be taken to achieve the decarbonisation target.

The recommendations in this Carbon Neutral Plan have been informed by carbon emissions modelling that accounts for key technological trends and policy changes that are expected to take place at national, regional and local levels over the coming decades. It also draws on detailed energy audits of the Councils' own building stock. Proposed actions have been developed through engagement with local stakeholders, to ensure that the Plan reflects the unique circumstances and priorities of Adur & Worthing Councils as they look towards the future.

1.3 Drivers for achieving Net Zero Emissions

A selection of targets, policies and initiatives aimed at reducing CO_2e emissions are described below. particularly those related to decarbonising heat, energy and transportation in Adur & Worthing.

Although it is not possible to fully capture the wide range of environmental, social, and economic drivers for taking action to address the threat of climate change, these are some of the key drivers that have been used to inform the analysis that underpin this Carbon Neutral Plan.

National

UK Climate Change Act 2008

The **UK Climate Change Act 2008 (2050 Target Amendment) Order 2019** legally commits the UK Government to reducing emissions by 100% by the year 2050, compared with a 1990 baseline.[3] As described by the UK Committee on Climate Change (CCC), *'The Act provides the UK with a legal framework including a 2050 target for emissions reductions, five-yearly 'carbon budgets' (limits on emissions over a set time period which act as stepping stones towards the 2050 target), and the development of a climate change adaptation plan.'*[4] The CCC is an independent statutory body which sets the magnitude of carbon budgets; the Government must prepare policies accordingly.

The Paris Climate Agreement

The UK ratified the Paris Climate Agreement in November 2016. The Agreement's central aim *'is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2° Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5° Celsius.'*[5]

[3] The original (2008) target of 80% was amended through subsequent legislation in 2019. *See 'The Climate Change Act 2008 (2050 Target Amendment) Order 2019'*: http://www.legislation.gov.uk/uksi/2019/1056/contents/made

[4] https://www.theccc.org.uk/tackling-climate-change/the-legal-landscape/

[5] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Building Regulations (Part L)

Part L of Building Regulations is the key mechanism that prescribes standards for the conservation of fuel and power in buildings in the UK, based on metrics such as the estimated level of energy demand and CO_2e emissions. At the time of writing, the Ministry of Housing, Communities and Local Government (MHCLG) has recently released a consultation on proposed Future Homes Standards, that would significantly reduce emissions from new domestic buildings in the UK.[6]

The Future Homes Standard

Under the Future Homes Standard, new buildings would be required to meet significantly higher targets for energy efficiency and carbon savings. The Government states that,

'As part of the journey to 2050 we have committed to introducing the Future Homes Standard in 2025. This consultation sets out what we think a home built to the Future Homes Standard will be like. We expect that an average home built to it will have 75- 80% less carbon emissions than one built to current energy efficiency requirements (Approved Document L 2013). We expect this will be achieved through very high fabric standards and a low carbon heating system. This means a new home built to the Future Homes Standard might have a heat pump, triple glazing and standards for walls, floors and roofs that significantly limit any heat loss.'

- BEIS, *'The Future Homes Standard Consultation'* (2019)

Note that future versions of Part L are expected to adopt carbon emission factors for grid electricity that are significantly lower[7] than those used in Part L 2013. This change would make it easier to achieve the required level of CO_2 savings using electric heating systems, and especially heat pumps, while making it harder to achieve using gas boilers.

The Clean Growth Strategy (2017)

The UK Clean Growth Strategy[8] was published in October 2017 and sets out the Government's vision for decoupling economic growth from carbon emissions. It includes objectives for increasing generation of energy from renewable sources, increasing the delivery of clean, smart and flexible power and accelerating the shift to low carbon transport, smart grids and energy storage.

The Road to Zero (2018)

The Road to Zero report,[9] published in July 2018, sets out the Government's core mission to '*put the UK at the forefront of the design and manufacturing of zero emissions vehicles and for all new cars and vans to effectively be zero emission by 2040.'* The strategy furthers the ambitions of the NO_2 plan[10] and Clean Growth Strategy in defining key policies with primary focus upon introduction of low and zero emission vehicles, with the aim that *'at least 50%, and as many as 70%, of new car sales and up to 40% new van sales being ultra low emission by 2030. By 2050 we want almost every car and van to be zero emission.'*

The Government has stated that local action will be supported through new policies, including provision of funding to extend ultra low emission bus schemes and taxi charging infrastructure. Goals aimed at encouraging uptake of new ultra low emission vehicles (ULEVs) will be backed by developing electric vehicle (EV) infrastructure, and offering funds and grants for provision of EV charging points. The Government also intends to support further research into zero emission vehicle

[6] BEIS, *'The Future Homes Standard Consultation'* (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/843757/Future_Homes_Standard_Consultation_Oct_2019.pdf

[7] Building Research Establishment, 'SAP 10 The Government's Standard Assessment Procedure for Energy Rating of Dwellings Version 10' (July 2018). Available at: https://www.bregroup.com/sap/sap10/

[8] HM Government *'Clean Growth Strategy'* (2017). Available at: https://www.gov.uk/government/publications/clean-growth-strategy

[9] HM Government, *'The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy'* (2018) Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

[10] Air quality plan for nitrogen dioxide (NO2) in UK (2017) https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017

design and manufacturing techniques and next generation battery technologies which would help to improve performance and promote uptake.

Regional

South2East Local Energy Strategy (2018)

The South2East Energy Strategy[11] was developed by three Local Enterprise Partnerships (LEPs), which are joint private / public organisations intended to drive economic growth in a broad geographic area encompassing Adur & Worthing. The Strategy outlines a vision for achieving clean growth through the year 2050, with a focus on the power, heat and transportation sectors.

It highlights several key opportunities for the region, including:

- Significant renewable energy potential, especially solar, wind, energy from waste and landfill gas;
- Rich natural assets (including a high proportion of woodland); and
- Large amounts of planned new development within the region, offering opportunities for deployment of smart, integrated, sustainable energy system models.

West Sussex County Council

The West Sussex County Council has produced an Energy Strategy and Action Plan (covering the period 2016-2020) to address key issues relating to energy in West Sussex, chief among which are security, affordability and sustainability. The documents provide a framework for the County Council to reduce energy demands and increase uptake of renewable technologies.

West Sussex County Council is also in the process of developing an Electric Vehicle Strategy (draft 2019). This states the ambition to ensure that at least 50% of all registered vehicles within the County are ultra low emission or electric (ULEV) by 2030, with an aspirational target of reaching 70% by that time. The Strategy further states that the West Sussex County Council will seek to ensure that sufficient charging infrastructure is installed to enable this shift, and that all charging points are supplied with 100% renewable energy.

SMARTHUBS – Smart Local Energy Systems (SLES)

West Sussex County Council is one of the main partners in Project SMARTHUBS. This initiative will see Adur & Worthing Councils working in collaboration with private sector partners to deliver new smart, local energy systems in West Sussex, with a particular focus on the Adur and Worthing area.

Some of the key aims of the project are to increase the amount of renewable electricity generated using solar photovoltaic (PV) systems and use this in combination with battery storage to power both domestic and commercial heat pumps. Notably, this will include the development of a district heat network (DHN) in the Shoreham Port area, which would provide customers with low carbon source of energy for heating.

Other SMARTHUBS projects will focus on delivering sustainable transport in the area, by linking solar photovoltaic (PV) arrays and battery storage to new EV charging infrastructure and investigating opportunities to power vehicles using hydrogen gas.

Local

Platforms for Our Places 2017-19

This programme[12] identifies opportunities to improve quality of life in Adur & Worthing by considering five key platforms *'upon which happy, healthy, prosperous, innovative, dynamic and sustainable communities can thrive.'*

[11] Energy South2East, *'South2East Local Energy Strategy'* (2018). Available at https://www.southeastlep.com/app/uploads/2019/03/Local-Energy-Strategy-FIN
[12] https://www.adur-worthing.gov.uk/media/media,151817,en.pdf

As part of this initiative, the Councils have made several commitments aimed at reducing emissions and shifting to clean energy across their estates. These include, but are not limited to:

- Developing a detailed understanding of the Councils' emissions, along with a strategy to save energy and reduce emissions;
- Retrofitting built infrastructure to improve environmental efficiency across corporate buildings and social housing stock; and
- Delivering further clean, renewable energy on Council buildings and sites, including a programme of solar photovoltaic (PV) installations.

Platforms for Our Places – Going Further 2020-2022

The new Platforms includes greater ambition on climate change following the Climate Emergency Declaration. Platform 3 has been renamed *Tackling Climate Change and Supporting the Natural Environment* in light of the heightened focus on climate change and carbon emissions reductions, and one of the new commitments below this includes greater focus on climate resilience.

SustainableAW 2018-2019

Building on the commitments made by Adur & Worthing Councils as part of Platforms for our Places, Sustainable AW is an initiative designed to address a wide range of environmental issues. These include biodiversity, carbon reduction, energy, transport, waste reduction and water.

SustainableAW 2020-2023

The refreshed SustainableAW introduces greater ambition, four additional areas of action, and proposes deeper engagement and collaboration with the local community and stakeholders. Thus, it provides a framework to address the crisis in natural ecosystems and the Climate Emergency declared by members at the Joint Strategic Committee on 9th July 2019.

SustainableAW 2020-2023 reflects and highlights Platform 3 commitments but includes a new layer of action that will be sought from community and businesses.

As part of these programmes, and reflecting a broader commitment to sustainability, Adur & Worthing Councils have already taken steps to reduce their environmental impact, including but not limited to:

- Sourcing renewable energy through their electricity contract;
- PV installations on Portland House and Shoreham Centre;
- Ground-source heating at the crematorium; and
- Ongoing LED lighting replacement across the estate.

Units for greenhouse gas emissions reporting: CO2e

A carbon footprint is measured in tonnes of carbon dioxide equivalent (tCO_2e). The carbon dioxide equivalent (CO_2e) allows the different greenhouse gases to be compared on a like-for-like basis relative to one unit of CO_2. CO_2e is calculated by multiplying the emissions of each of the six greenhouse gases by its 100 year global warming potential (GWP).

A carbon footprint considers all six of the Kyoto Protocol greenhouse gases:

Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF_6).

- Carbon Trust, *'CTV043 Carbon Footprinting'* (July 2019)

2. Where we are: The carbon emissions baseline

2.1 Scope of the analysis

For the purpose of greenhouse gas reporting, emissions are divided into three categories:

- **Scope 1** – Direct emissions from sources owned or controlled by AWC. This primarily includes fuel used in boilers to provide heating and hot water and fuel used in vehicles. This is limited to buildings and vehicles where the Councils are responsible for paying the fuel bills.
- **Scope 2** – Indirect emissions associated with the use of electricity purchased by AWC.
- **Scope 3** – Indirect emissions that result from other activities that occur in the value chain of AWC, either upstream or downstream. This includes emissions associated with buildings and services linked to the Councils but where they are not responsible for paying the fuel bills, for example leased properties, the leisure centres and the waste management system. It also includes business travel using non-Council owned vehicles.

The baseline for the Council's emissions include Scope 1, 2 and some Scope 3 emissions. In the future, additional data collection could be undertaken to better understand the Councils' Scope 3 emissions. These would include, for instance, emissions from waste disposal, and procurement.

2.2 Carbon emissions in 2018/19

Based on metered gas and electricity consumption and recorded vehicle use, we estimate that the annual Scope 1 and 2 emissions were approximately 2,908 tCO_2e in the year from April 2018-March 2019. Scope 3 emissions from water consumption and business travel each amount to approximately 33 tCO_2e p.a. and emissions from the Worthing Leisure Centre and Splashpoint[13] account for a further 1,015 tCO_2e p.a. Table 1 presents a breakdown of the Councils' emissions by category and fuel type, and the results are illustrated in Figures 1 and 2. ('External' refers to both external lighting and CCTV.)

	Buildings		**Transport**			**Water**	**TOTAL**	
	Electricity	**Gas**	**Diesel (HGVs)**	**Diesel (Vans)**	**Petrol or Hybrid Vehicles**	**Fuel not specified**	**Total**	*% of total*
Non-residential	484	422	-	-	-	-	905	*31%*
Residential	75	346	-	-	-	-	420	*14%*
External	205	-	-	-	-	-	205	*7%*
Crematorium	57	448	-	-	-	-	505	*17%*
Transport		-	746	107	19	-	873	*30%*
Total Scope 1 & 2	**820**	**1,215**	**746**	**107**	**19**	**-**	**2,908**	
*% of total**	*28%*	*42%*	*26%*	*4%*	*1%*	-		
Water consumption	-	-	-	-	-	33	33	N/a
Business travel	-	-	-	-	-	33	33	N/a
Leisure Centre & Splashpoint	899	116	-	-	-	-	1,015	N/a
Scope 3 (assessed)	**899**	**116**	**-**	**-**	**-**	**66**	**1,081**	**N/a**

Table 1: Adur & Worthing Council Scope 1, 2 and 3 CO_2e emissions

** Values may not sum due to rounding.*

[13] Note that emissions from the Leisure Centre and Splashpoint have been estimated using 2014-15 data.

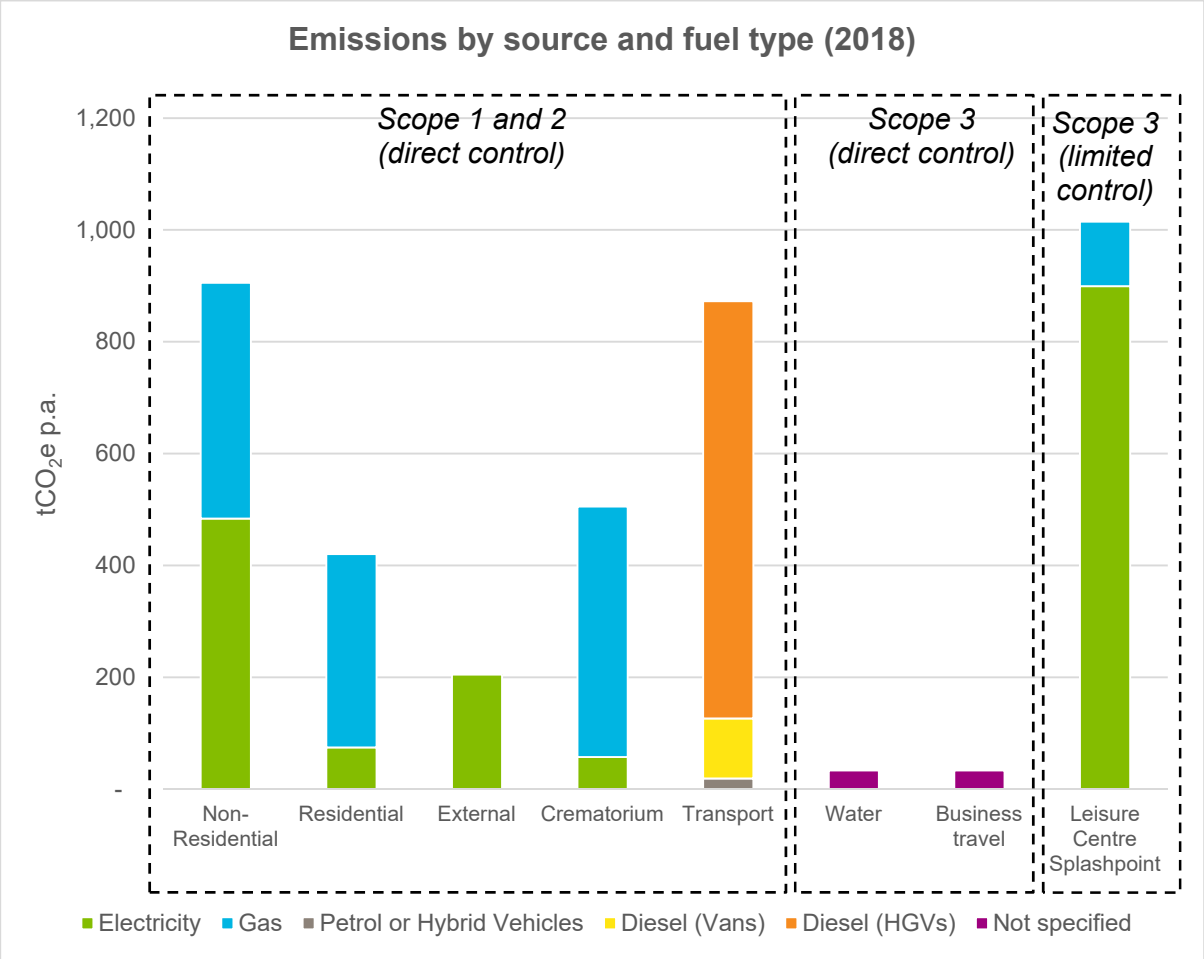


Figure 1.Emissions by source and fuel type (2018/19)

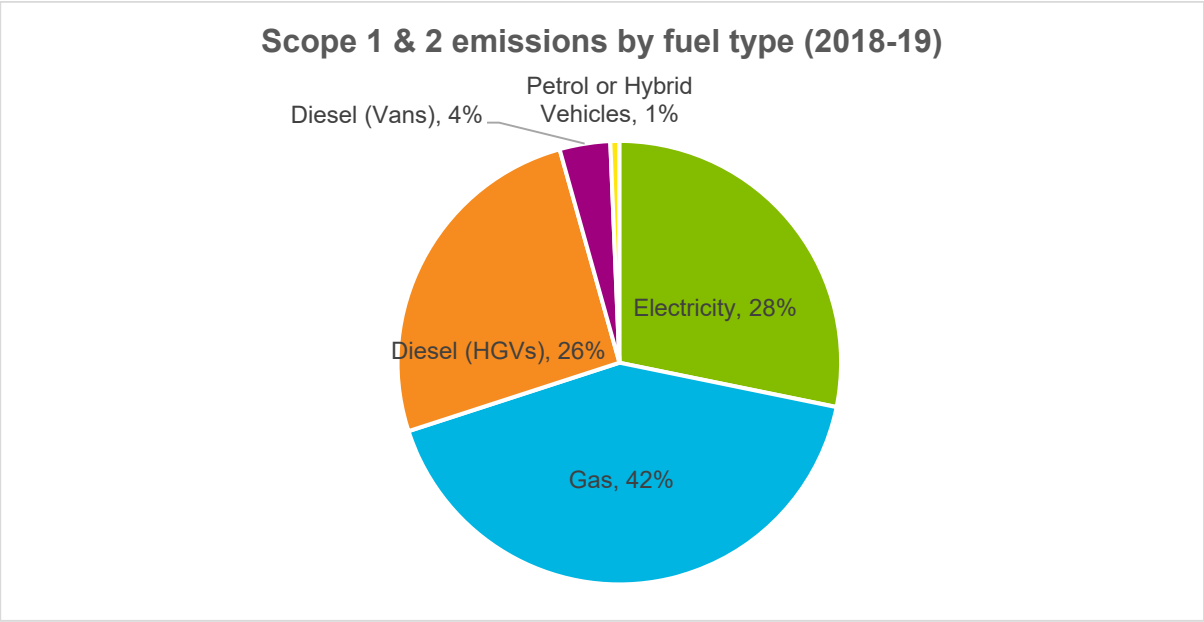


Figure 2: Scope 1 and 2 CO_2e emissions by fuel type (2018/19)

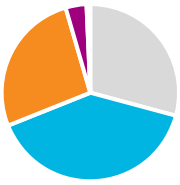
Results show that gas and electricity use in buildings accounts for the majority of Scope 1 and 2 emissions (42% and 28%, respectively). The next biggest contributor is fuel use for HGVs (26%). Other vehicles such as cars and diesel vans make up for around 5%. The crematorium also represents a major source of CO_2e emissions, primarily due to the gas used for heat.

Based on available data going back to 2011/12, the Councils' Scope 1 and 2 emissions have decreased by approximately 20% overall and 23% since 2013/14. It is important to note that the

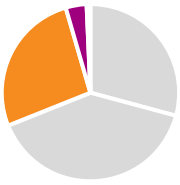
annual Scope 1 and 2 emissions vary significantly over time, partly as a result of the decarbonisation of electricity supplied by the national grid but also due to a variety of factors not assessed in detail in this report. These include factors such as weather and user behaviour, but a key sensitivity is linked to changes in the Councils' ownership or operation of buildings or provision of services. As an example of the potential scale of impact this would have, if the Councils owned and operated the Worthing Leisure Centre and Splashpoint, their Scope 1 and 2 emissions would increase by around 36%.

2.3 Implications for the Carbon Neutral Plan

Considering the breakdown of Adur & Worthing Councils' current CO_2e emissions, the Carbon Neutral Plan will need to include targeted intervention measures that contribute towards the following goals:



Reduce electricity demands
and use renewable electricity



Reduce heating demands
and phase out natural gas

Switch to ULEV cars / vans
and reduce demand for transport

Investigate options for
reducing HGV emissions

Seek to understand and reduce
Scope 3 emissions

The 2018/19 baseline essentially provides a 'snapshot' view of priorities for Adur & Worthing Councils. Therefore, in order to gain a better understanding of the potential changes over time, high-level modelling has been carried out to project carbon emissions to 2030. The aim is to show the relative scale and direction of changes that could affect the Councils' CO_2e emissions in the years ahead and show a range of potential routes towards achieving the decarbonisation target.

3. Routes to Net Zero: Projections to 2030

3.1 Modelling approach

The analysis presented in this report considers interventions that would be led by the Councils (e.g. switching to 100% electric vehicles), but also accounts for wider trends (e.g. decarbonisation of the national electricity grid). Key assumptions are outlined below. The methodology is described in detail in Appendix A.

- **National electricity grid decarbonisation** – The emission factor for grid electricity is expected to continue to decrease over time, as it will be generated using less fossil fuel and more renewable energy. This analysis considers the impact of a grid decarbonisation trajectory published by BEIS for use in organisational CO_2e emissions reporting and projections, which is illustrated in Figure 3.[14] Although not a prediction, the trajectory reflects the ambitions set by the Government and seen as necessary to meet the UK's carbon emission reduction commitments.

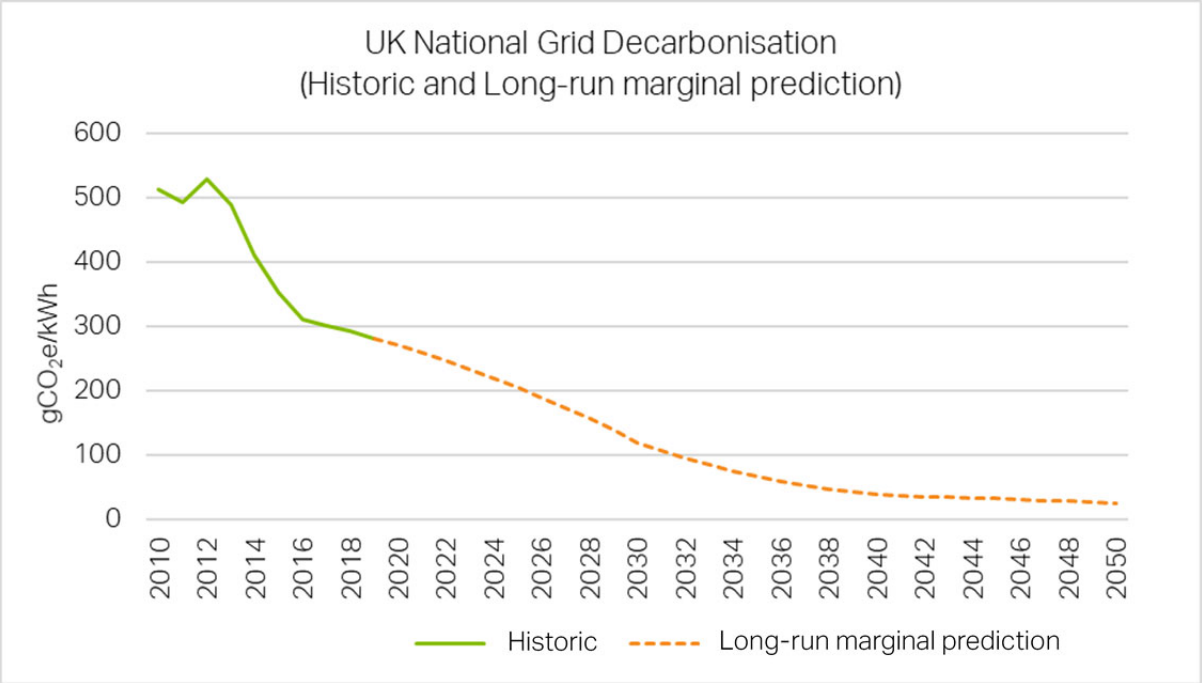


Figure 3: Historic and Long-run marginal grid decarbonisation

- **Energy demand reduction** through energy efficiency measures and behaviour change – Based on statistics provided in the UK National Energy Efficiency Database (NEED)[15] we have assumed that fabric upgrades could reduce demand for heating by around 10%, and that electricity use could decrease by around 5% through a combination of behavioural change measures and smart energy management.

- **Switching from the use of gas-fired heating to electric systems** – Based on metered gas data, and accounting for differences in the typical performance of gas boilers, direct electric heating, and heat pumps, we have estimated the change in fuel use if the total 2018/19 heating requirements were met by these alternative heating technologies.

- **Reducing demand for transport –** Based on case studies of mileage reduction in similar organisations, we have assumed that a 10% reduction in mileage could be achieved, for instance, by using smart route planning, or taking measures to promote a shift towards walking, cycling,

[14] BEIS, *'Green Book Supplementary Guidance: Toolkit for valuing changes in greenhouse gas emissions, Table 1'* (2019). Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[15] NEED, *'Summary of Analysis, Great Britain'* (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/812561/National_Energy_Efficiency_Data_Framework__NEED__report_summary_of_analysis_2019.pdf

ridesharing and public transport.[16] Due to technological obstacles, we have assumed that HGV emissions reductions will be capped at 15%.

- **Uptake of Ultra Low Emission Vehicles (ULEVs)** in the Councils' vehicle fleet and pool cars – In line with assumptions made by the Department for Transport's *'Road to Zero'* (2018) report, we have assumed that ULEV uptake will increase rapidly in the coming decade and therefore aside from HGVs, all vehicles operated by AWC could be ultra-low emission (powered either by hydrogen or electricity) by 2030.

The model assumes that, in a hypothetical 'No Action' or 'Business as Usual' scenario, no actions are taken to reduce emissions, there is no change to the Councils' building portfolio or vehicle fleet, fuel consumption remains steady, and total CO_2e emissions do not change over time.[17] This is used as a baseline for assessing the cumulative impacts of the intervention measures.

It is important to note that these scenarios are *not* intended to predict actual fuel consumption or CO_2e emissions. Instead, the analysis highlights priority measures for reducing emissions, which in turn informs the actions and recommendations laid out in Section 4.

3.2 Carbon emissions projections

The graphs below show historic emissions for the Councils, along with a hypothetical 'Business as Usual' trajectory. The other routes to net zero show the cumulative impact of sequentially adopting measures to:

1. Reduce energy demands in buildings;
2. Switch from gas boilers to efficient electric heating systems;
3. Reduce vehicle mileage;
4. Switch from petrol and diesel vehicles to ULEV (electric or hydrogen) vehicles; and finally
5. Offset residual CO_2e emissions to reach the net zero target. Note that this trajectory is purely illustrative and is intended to provide an estimate of the amount of low and zero carbon (LZC) electricity generation or carbon offsetting that would be required.

[16] Department for Transport and Energy Savings Trust *'Mileage Management – A Guide For Fleet Managers'* (2015). Available at: https://www.energysavingtrust.org.uk/sites/default/files/reports/4548_EST_A4_mileage_mmt_4.pdf

[17] In reality CO_2e emissions depend on many variables, including economic trends, energy prices, and weather, to name only a few. For example, see National Grid *'Future Energy Scenarios'* (2019). Available at: http://fes.nationalgrid.com/fes-document/

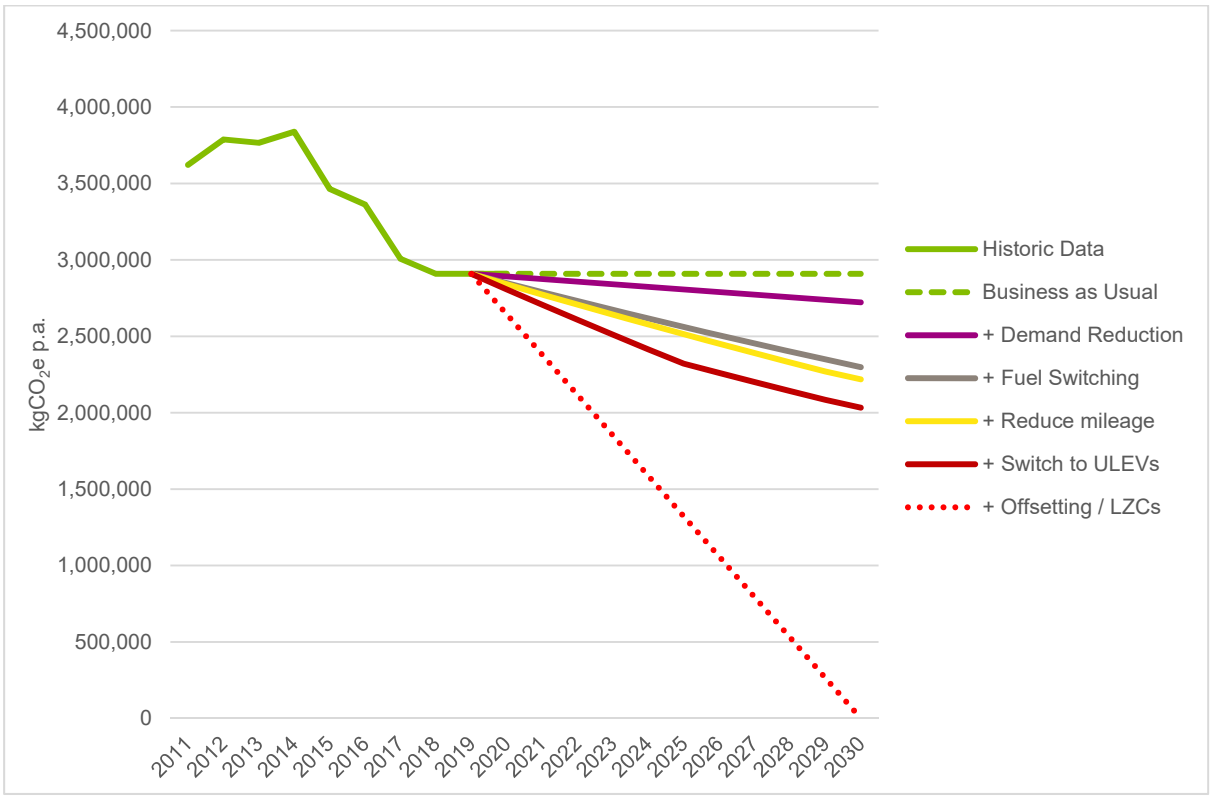


Figure 4: Scope 1 and 2 emissions – No change to electricity grid emissions

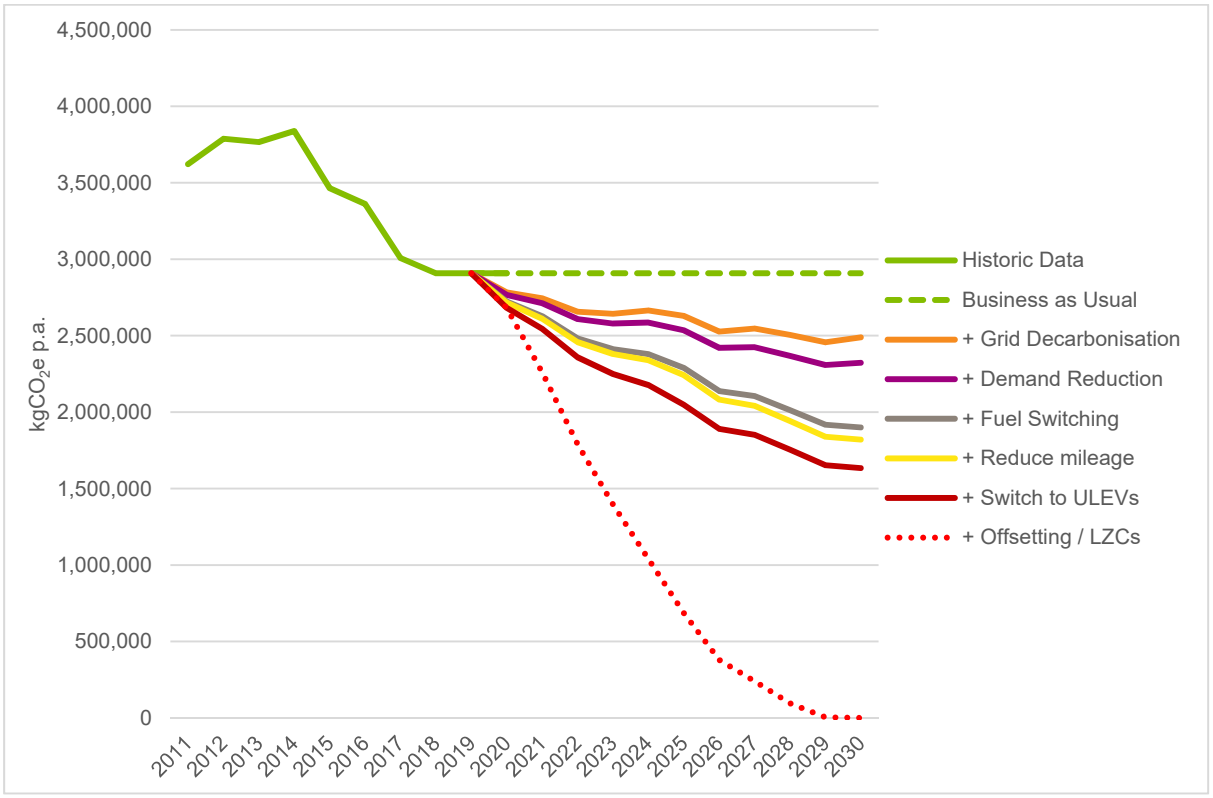


Figure 5. Scope 1 and 2 emissions – Accounting for grid decarbonisation

Figure 4 shows the potential CO_2e reductions that could be achieved assuming that there is no change in the national electricity grid. In this scenario, if all measures (excluding renewables and offsetting) are adopted, this would reduce Scope 1 and 2 emissions by 30% by 2030. The residual emissions (2,032 tCO_2e p.a.) would need to be made up for through renewable electricity generation and carbon offsetting. For context, this would require around:

- 17 MW of ground-mounted PV (i.e. solar farms totalling around 85-90 acres of land); or
- 6 MW of large-scale onshore wind (3-6 large turbines); or
- Approximately 575 hectares (5.8 square kilometres) of new woodland.

By contrast, Figure 5 shows what would happen using the same assumptions, assuming the electricity grid decarbonises at the rate suggested by the BEIS Green Book Guidance.

In this scenario, if all measures (excluding renewables and offsetting) are adopted, this would reduce Scope 1 and 2 emissions by 44% by 2030. The residual emissions (1,634 tCO_2e p.a.) would need to be made up for through renewable electricity generation and carbon offsetting.

However, because the CO_2e savings from renewable technologies are measured by the amount of grid electricity that they *displace*, as the grid decarbonises, more LZC energy generation is needed to offset the same amount of CO_2e emissions. (This issue does not apply to woodland creation, which will sequester the same amount of CO_2 independent of the electricity grid). Therefore, based on BEIS carbon emission factors (CEFs) for grid electricity in 2030 (see Figure 3), offsetting this amount of CO_2e would require:

- 24 MW of ground-mounted PV (up to 120 acres of solar farm); or
- 9 MW of large-scale onshore wind (4-9 large turbines); or
- Approximately 460 hectares of new woodland (4.6 square kilometers) – note that sequestration rates do not depend on grid emission factors as the mechanism for CO_2e reduction is different.

In reality, there is significant uncertainty regarding the level of CO_2e saving measures that can be implemented in the given timeframe, in which case offsetting the Councils' emissions would require even more investment in LZCs and woodland creation than cited above.

This emphasises the fact that grid decarbonisation and offsetting will not be enough for Adur & Worthing to achieve their 2030 target – it must be supported by strong actions to reduce demand for fuel in buildings and transportation and eliminate the use of fossil fuels.

Impact of grid decarbonisation

A comparison of these results shows that grid decarbonisation is one of the most important variables that will determine whether the Councils are able to meet the net zero target. This has both positive and negative implications. On one hand, if the BEIS decarbonisation scenario were to occur, the Councils' Scope 1 and 2 emissions could decrease by up to 14% even if no other actions were taken. On the other hand, this presents a key risk, because it means that much of the reliance on achieving the net zero target will rely on factors outside of the Councils' control.

To address and mitigate this risk, consideration must be given to how the Councils can best facilitate the government's objectives in decarbonising the grid as well as what measures they can take to best insulate itself from the eventuality that grid decarbonisation does not happen as quickly and / or as deeply as the Government intends. [18]

[18] Although there has been significant progress in this area in recent years, future decarbonisation is anticipated to be much more difficult to achieve. To date, the decarbonisation of the national grid has been primarily achieved through the significant reduction in the use of coal fired power stations and the increase in the use of renewable technologies, particularly large-scale wind and biomass (where it is used for co-firing in power stations). However, the use of gas remains a significant component of the generation mix and the timely replacement of the existing nuclear fleet is already proving to be challenging. Furthermore, significant additional pressures from the use of electricity to provide heating and power vehicles may incentivise firm power generation from fossil fuel sources to deal with greater peaks in demand.

Reducing demands for electricity and heating

The demand reduction measures modelled in this report have relatively little impact when considered on their own, reducing the Councils' Scope 1 and 2 emissions by around 6% overall. The analysis uses a conservative estimate of the potential reduction in demand that could be achieved; this suggests the need for a more ambitious programme of energy efficiency improvements.

Furthermore, demand reduction is a crucial prerequisite for successfully switching towards the use of electric heating and vehicles. For instance, energy efficiency improvements in buildings enable systems such as heat pumps to work at a higher level of efficiency. Similarly, a large-scale shift to the use of electric vehicles must be accompanied by a significant modal shift towards walking, cycling, ridesharing, and an increase in the use of public transport.

One of the key obstacles to achieving this would likely be the absence of a policy driver that requires energy efficiency upgrades to existing buildings. The Minimum Energy Efficiency Standards (MEES) regulations are intended to drive progressive improvements in the existing stock but the impact this will have is not yet clear. Therefore, it will be important to identify any potential sources of funding to implement this measure. AWC could also consider lobbying the Government to promote additional regulations in this area.

Minimum Energy Efficiency Standards

Under the MEES regulations, as of 1st April 2018, any properties newly rented out in the private sector must have a minimum Energy Performance Certificate (EPC) rating of E (some exceptions apply). Fines will be applied for non-compliance.

Owners of buildings with a lower EPC rating will be required to implement energy efficiency measures, though consideration will be given to financial viability, the anticipated payback time and impacts on property value.

Over time, the Government intends to progressively increase the minimum EPC rating, meaning that buildings must become more efficient in order to be sold or rented. A recently-published consultation proposed that the minimum rating should be raised to B by 2030, subject to actions meeting a seven-year payback test.

- BEIS, *'The Non-Domestic Private Sector Minimum Energy Efficiency Standards: The Future Trajectory to 2030'* (2019)

It is important to note that there are important reasons other than reducing carbon emissions which support refurbishing the existing stock. Fabric and building services efficiency improvements can help to protect consumers against changes in fuel prices, mitigate fuel poverty and improve health, wellbeing and comfort. Similarly, reducing vehicle mileage, if accompanied by increased walking and cycling, can also improve health. Alongside this, ULEVs will have significant benefits in relation to improvements in air quality.

Phasing out natural gas

Unlike electricity, which can be generated from a range of renewable technologies, natural gas is a fossil fuel which unavoidably emits CO_2 during combustion. In order to meet the net zero target, it will therefore be crucial to phase out the use of gas, because the scale of investment that would be required to offset these emissions would be significant.

The two main options for achieving this, based on currently available technologies, are to (1) reduce the total demand for heat and (2) switch to using electric heating systems such as direct electric heating (DEH) or heat pumps.[19] This would have the effect of reducing the Council's emissions by up to 20%, depending on the technology used. As the electricity grid decarbonises, the savings would increase, so fuel switching (with necessary enabling works) could potentially result in a 35% decrease in emissions by 2030.

[19] It may be possible to decarbonise the gas grid by injecting it with biomethane or hydrogen, but this would require a technological step-change and has therefore not been considered given the timeframe for the Councils to reach net zero.

Heat networks have also been identified by the Government as a key component of the move to decarbonise the supply of heat. A heat network involves the centralised generation of heat to serve multiple buildings. Future heat networks will need to deliver low or zero carbon heat and therefore are likely to utilise heat pump technology or waste heat sources. The advantage of a heat network is that a single project can enable multiple buildings to switch to a low carbon heat source in one go, speeding up the process of fuel switching. Heat networks can also enable the use of lower carbon heat, larger and more efficient equipment, thereby delivering higher carbon savings with lower capital and operational costs than solutions for each individual building.

Switching to ultra-low emission cars and vans

Switching to ULEVs where possible would reduce emissions by around 1% if they were charged using national grid electricity. The savings would increase as the electricity grid decarbonises, or if the vehicles were charged using renewable energy – for instance, generated by PV on the roof of a Council-owned car park. This would deliver savings of up to 4%.

The electric vehicle market has seen considerable growth in recent years, and it is estimated that the price of electric, hybrid and traditional fuel cars could converge within the next decade.[20] The Councils should take this into account in their fleet replacement strategy.

Although switching to ULEVs will be an important part of reaching the decarbonisation target, even if this goal is achieved, it creates additional challenges. For instance, the Councils will be more reliant on electricity emission factors for achieving their net zero target. It will also create pressure on grid infrastructure, which may not have the capacity to accommodate such a shift and require the use of more renewable electricity generation to meet demand.

The National Grid report *'Future Energy Scenarios 2019'* suggests that there could be between 2.7 and 10.6 million EVs on the roads by 2030, which would present a broad-ranging challenge across all areas of electricity infrastructure.[21] The use of smart EV charging and, potentially, vehicle-to-grid systems could mitigate some of the effects on peak demand and help to alleviate some of this pressure.

Reducing emissions from HGVs

At the time of writing, ultra low emission HGVs are not widely commercially available and are not expected to become so in the next decade. Barring a technological step-change, this would present a challenge in reaching net zero emissions, which will require all the existing HGV fleet to be switched from diesel to ULEV alternatives. Adur & Worthing Councils will need to be mindful of the development of this technology and undertake a review when the existing fleet is due for renewal.

In the short-term the Government has suggested a target of reducing emissions from HGVs by 15% through other measures such as driver training. Adur & Worthing Councils will therefore need to assess whether such measures can be implemented within their own fleet. Reducing HGV emissions by 15% would reduce the Councils' Scope 1 and 2 emissions by roughly 4% overall.

Increasing renewable electricity generation

As buildings and vehicles switch away from the use of fossil fuels and towards electricity, it becomes increasingly important to ensure that electricity is supplied from renewable sources. Reasons include:

- Mitigating pressure on the national grid, which reduces the amount of resources needed for improving power infrastructure;
- Providing security of electricity supply, particularly when this is being used to supply heating;
- Helping to protect against electricity price increases; and
- Achieving higher CO_2e reductions in the event that the national grid does not decarbonise as quickly and / or as deeply as the Government intends.

[20] Cambridge Econometrics and Element Energy, *'Fuelling Europe's Future: How the transition from oil strengthens the economy'* (2018). Available at: https://europeanclimate.org/wp-content/uploads/2018/02/FEF_transition.pdf
[21] National Grid, *'Future Energy Scenarios'* (2019). Available at: http://fes.nationalgrid.com/media/1409/fes-2019.pdf

Offsetting residual emissions

The scenario testing demonstrated that, even with the most optimistic assessment of grid and transport decarbonisation and highest levels of uptake for energy efficiency measures, there will be significant residual CO_2e emissions that would require offsetting.

Further work and consultation would be required to identify the most appropriate and cost-effective opportunities, but these might include tree planting or new woodland creation. The UK Woodland Carbon Code, for instance, provides a means of gaining certification for this type of project.[22]

Reducing Scope 3 emissions

Scope 3 emissions from water consumption can be reduced through installation of water-efficient fittings and behavioural change programmes. Case study evidence suggests that these types of interventions could potentially reduce water use by more than 20%.[23]

The Councils should also investigate opportunities for reducing energy demands and switching to decarbonised heat sources in the properties that they lease, or those that they own but lease to others. For instance, AECOM's audit of the Worthing Leisure Centre has identified significant CO_2e savings.

3.3 Key findings of the analysis

The table below summarises the potential impacts of the measures described above. It reports the maximum potential percentage (%) reduction in CO_2e that could be achieved through adoption of each measure, compared with a 'Business as Usual' baseline.

Potential change in carbon emissions from these measures…	Without grid decarbonisation	With grid decarbonisation
Changes to electricity grid		
Grid decarbonisation, no other changes	N/a	-14%
Demand reduction in buildings		
Reduce demand for electricity and heat	-6%	-20%
Reduce demand and switch to electric heating systems	-20%	-35%
Low carbon transport		
Mileage reduction, no other changes	-3%	-3%
Switch to ULEVs (excludes HGVs)	-1%	-4%
Reduce emissions from HGVs	-4%	-4%
Total reductions		
All measures implemented (excluding offsetting / renewables)	-30%	-44%
Residual emissions to be offset (tCO_2e p.a.)	2,032	1,634

Table 2. Key findings of the analysis

Other opportunities to reduce emissions

These technologies have not been included in the quantitative analysis above, but should be considered by Adur & Worthing Councils to help enable their decarbonisation target:

- **District heat networks.** Heat networks offer an opportunity to switch multiple buildings on to lower carbon heating systems and use larger and more complex technologies to deliver higher carbon savings with lower overall capital and operational costs than addressing each building separately. By virtue of being larger projects, they can be more complex to deliver, although the

[22] https://www.woodlandcarboncode.org.uk/
[23] The Ripple Effect, *'Cost-effective water saving devices and practices'* (2005). Available at: http://www.wrap.org.uk/sites/files/wrap/GG522_commercial%20Cost-effective%20water%20saving%20devices%20and%20practices%20for%20commercial%20sites.pdf

Government is providing technical support and funding through the Heat Network Delivery Unit and Heat Network Investment Programme to assist local authorities in delivering these projects.

- **Smart energy management:** One of the key benefits of smart meters that they improve transparency and user access to energy data, making it easier to identify areas of waste. Although it is not clear to what extent this affects user behaviour in the long term, the improved data collection could also facilitate the introduction of demand side response, and on a broader scale, help to balance energy demand and supply, which is particularly important at peak times.[24] In principle, therefore, these have the potential to reduce fuel consumption and carbon emissions.

- **Battery storage:** There have been significant improvements in battery storage in recent years, with implications for fuel consumption across all sectors. Although batteries are likely to become crucial to future energy infrastructure, they do not offer CO_2e savings per se. Instead, they help to facilitate uptake of LZC technologies by moderating the intermittency of wind and solar energy generation. Combined with EV uptake and the introduction of vehicle-to-grid systems, this could have a transformative effect on the design of energy infrastructure and the built environment.

- **Carbon capture and storage:** At present, carbon capture and storage technologies have been deployed as pilot projects in the UK. Although these form part of the Government's '*Clean Growth Strategy'* (2017), at present there is insufficient evidence to provide a realistic estimate of their potential contribution towards the decarbonisation target.[25]

Potential increases in CO_2e emissions

Adding to the Councils' building portfolio

In the event that Adur & Worthing Councils build or purchase additional buildings, this would likely increase the Councils' Scope 1 and 2 emissions. Any increase will make the decarbonisation target more difficult to achieve and increase the cost of mitigation measures and offsetting. Therefore, it will be vital to ensure that any new buildings are constructed or retrofitted to be capable of becoming net zero in operation[26] and incorporate LZC technologies as standard.

Although not captured in existing datasets, it is also worth noting that there are Scope 3 CO_2e emissions associated with the construction and demolition process itself, as well as the materials used in construction. In order to minimise these emissions, the Councils should also consider:

- Carrying out a comprehensive options assessment to consider whether it is necessary to build new, and how to maximise the use of existing buildings, materials, and infrastructure;
- Use of renewable energy on-site (i.e. avoid diesel generators);
- Routinely carrying out embodied carbon lifecycle assessments of all proposals;
- Maximising the end-of-life value of any buildings, materials and infrastructure that cannot be reused by assessing opportunities for reclamation, remanufacturing, recycling, etc.; and
- Designing new buildings to facilitate maintenance (e.g. through use of robust materials) and future changes in use (e.g. generous floor to ceiling heights) so that, in the future, demolition and new construction can be avoided.

A note on overheating, cooling and climate change

Although one of the biggest challenges in decarbonising buildings in the UK relates to heat demand, it is generally agreed that demand for cooling is likely to increase in the future as a result of climate change.[27] Therefore, when considering interventions in their own building stock, it will be important for Adur & Worthing Councils to:

- Prioritise passive cooling measures, in order to reduce the need for air conditioning;
- Deliver cooling efficiently using highly efficient systems; and

[24] BEIS, 'Smart Meters and Demand Side Response' *https://www.gov.uk/government/publications/smart-meters-and-demand-side-response*
[25] For more information, see https://www.gov.uk/guidance/uk-carbon-capture-and-storage-government-funding-and-support
[26] For more information, see https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings
[27] JRC Science for Policy report by the European Commission, *'Assessment of the impact of climate change on residential energy demand for heating and cooling'* (2018)

- Incorporate building-mounted PV where possible, as solar panels will tend to generate more power on hotter days with higher cooling demands.

4. Achieving Net Zero: A plan for Adur & Worthing

4.1 Action Plan

Key areas of influence

As discussed previously, although the Councils have control over their own Scope 1 and 2 emissions to some extent, achieving the decarbonisation target will also depend on wider changes, including some that occur on a primarily national or regional level. However, the Councils do have opportunities to exert pressure across multiple spheres of influence, even if this is indirect, as illustrated in Figure 6.

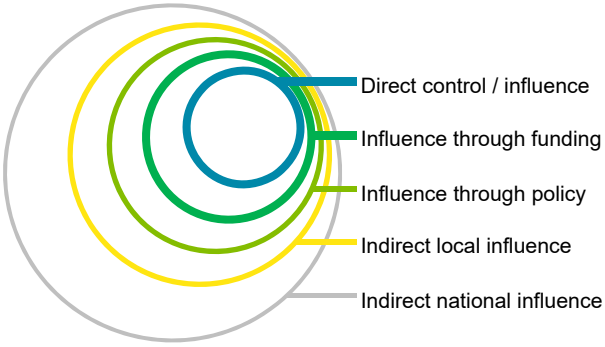


Figure 6: Adur & Worthing Councils - Spheres of influence

On this basis, potential responses from Adur & Worthing Councils could include:

- **Direct control:** Taking a leadership role by adopting best practices wherever possible by reducing energy demand in their own buildings, adopting behavioural change programmes, switching to renewable energy sources and adopting a zero-emission vehicle fleet.
- **Buildings /services owned but not operated by the Councils:** Engaging with tenants and service users to promote demand reduction measures, encourage uptake of renewables, etc.
- **Procurement:** Ensuring that there is a rigorous approach to embedding sustainability into procurement, e.g. with reference to Government Buying Standards, the Flexible Framework, and British Standard 8903:2010.

In addition to mitigating their own emissions, the Councils should also take a leadership role and consider ways they can exert influence within the local area and their supply chain; for instance:

- **Influence through funding:** For instance, by offering subsidies to SMEs wishing to undertake building energy audits.
- **Influence through policy:** Supporting the delivery of heat networks and renewable energy projects within the area by taking a positive approach to renewable energy generation in planning policies and decision-making.
- **Minimising emissions from transport in the local area** through design of infrastructure and traffic management, adopting an approach to spatial planning that reduces reliance on private vehicles, and supporting initiatives to encourage the use of public transport, ridesharing, walking and cycling.
- **Supporting higher standards of sustainable design and construction.** This could be done through awareness and training; for instance, by establishing best practice networks or offering training to facilities managers.
- **Exerting indirect national influence:** Lobbying the Government to bring forward more ambitious policies (e.g. transport strategies, research and development, updates to Building Regulations).

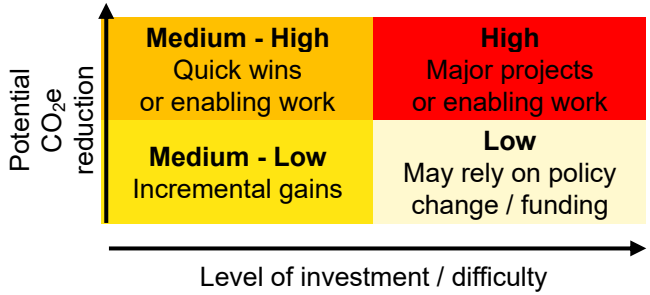
Action Plan

The following pages describe a set of proposed actions for Adur & Worthing Councils that reflect the findings of the analysis presented in Sections 2 and 3. These actions must be reviewed and agreed by the Council prior to being adopted and taken forward. The proposed actions have been presented with the following information:

- **Reference code**
- **Action** – Summary of the proposed action
- **Description** – Any other relevant details relating to the proposed action
- **Timeframe** – Describes the timeframe (short, medium or long-term) during which the proposed action needs to be initiated, either short term (0-6 months), medium term (6-12 months) or long term (1-5 years)
- **Effectiveness –** Framed in terms of the level of potential CO_2e reductions that could be achieved, informed by the analysis presented in Sections 2 and 3
- **Deliverability/Roles** – Key considerations and relative effort required, considering factors such as Adur & Worthing Councils' level of influence or role in delivery and required involvement of other parties
- **Investment Resource implications** – Describes the relative level of resource (e.g. officer time) that Adur & Worthing Councils would need to commit in order to deliver the proposed action. Where possible / applicable, we have provided an estimate of the scale of investment required, based on published industry figures and AECOM's own experience in delivering similar projects.

  Note that these are preliminary figures intended only to provide a sense of potential scale of investment required, subject to further detailed analysis. These are labelled as 'investments' rather than costs because many of them have potential financial returns and some or all of the required financing could come from other parties.

- **Priority** – Sets out the relative priority of the proposed action, based on the considerations listed above. Note that some projects with a higher priority ranking may not result directly in carbon savings but enable other high-priority actions to take place. This is illustrated in the diagram below.



The actions are grouped into the following broad categories: General actions (G); Supporting grid decarbonisation (D); Demand reduction (R); Low carbon heating systems (H); Building integrated renewable energy generation and storage (E); Low carbon transport (T); Offsetting (O); and Scope 3 emissions (S).

LEGEND

Measures affecting Scope 1 and 2 emissions (and Scope 3 emissions within the Councils' direct control)

Measures that would impact Scope 3 emissions (indirect or partial control)

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
	General actions						
G1	Disseminate the results, conclusions and recommendations of this study within AWC	Send out copies of the report and promote the Carbon Neutral Plan to build capacity and support for taking recommendations and actions forward.	Short term	N/a – enabling action	Internal action (AWC)	Limited officer resource required	N/a – enabling action
G2	Formally adopt the Carbon Neutral Plan	Formally adopt the actions and recommendations of the Carbon Neutral Plan to secure political commitment.	Short term	N/a – enabling action	Internal action (AWC)	Limited officer resource required	N/a – enabling action
G3	Identify senior officers and members to champion the programme and key projects	Senior officer and members will be vital in taking forward the recommendations and actions proposed.	Short term	N/a – enabling action	Internal action (AWC)	Limited officer resource required	N/a – enabling action

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
G4	Establish a means of monitoring and reporting progress against the recommendations and action plan	Establish reporting timetable. Set up a monitoring and reporting mechanism to assess progress over time and re-assess actions and priorities where relevant.	Short to medium term	N/a – enabling action	Relatively straightforward but will require AWC officer(s) to become familiar with existing data, tools and resources. Additional complexity will be added depending on the scope of monitoring. For guidance, see BEIS, *'Emissions reduction pledge 2020: Emissions reporting in public and higher education sectors'* (2018).[28]	Officer resource required	N/a – enabling action
G5	Establish roles for delivering the recommendations and actions	The agreed set of actions following on from this study should be allocated to specific officers within AWC to ensure responsibility for delivery.	Short term	N/a – enabling action	Internal action (AWC)	Officer resource required	N/a – enabling action
G6	Work with Government and other Local Authorities to identify existing and forthcoming funding sources to support further studies and specific projects	Many of the measures identified in this report will have significant capital cost implications and therefore funding may be required to support their implementation. Any further work to	Short term but must be ongoing to reflect future opportunities	N/a – enabling action	AWC to work with government and other local authorities	Officer resource required	N/a – enabling action

[28] Available at: https://www.gov.uk/government/publications/emissions-reduction-pledge-2020-emissions-reporting-in-public-and-higher-education-sectors

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
		define specific project opportunities should include an analysis of funding options.					
G7	Begin reaching out to stakeholders to identify opportunities for collaboration and engagement	This includes local authorities, LEPs, utility companies (e.g. UKPN, Southern Gas), government departments / agencies (e.g. Department for Transport, Department of Environment, Food and Rural Affairs, and the Forestry Commission), and others (e.g. WRAP) where linked to other actions in this Plan.	Short term	N/a – enabling action	AWC to meet with stakeholders	Limited officer resource required	N/a – enabling action
G8	Implement recommendations from energy audits	Review the recommendations from energy audits carried out to date and ensure that these are reflected in any repair / maintenance plans for buildings.	Short to medium term	High	AWC to review recommendations. Actual delivery may be challenging, costly and/or disruptive.	High level of investment required – refer to separate energy audit reports	High
	Grid decarbonisation						
D1	Speak to UKPN about future energy infrastructure plans	Arrange a meeting with UKPN to discuss plans for future energy	Short term	N/a – enabling action	AWC to meet with UKPN and other stakeholders.	Limited officer resource required	N/a – enabling action

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
		infrastructure in the area and how AWC can support and facilitate this through planning policy and other mechanisms.			This should be done in parallel with Actions T1-T4 which relate to low carbon transport infrastructure.		
D2	Monitor progress on national decarbonisation	Monitor progress towards national grid decarbonisation to understand the implications for meeting the decarbonisation target. This can be done by accessing national (BEIS) datasets on an annual basis.	Medium to long term	N/a – enabling action	Relatively straightforward but will require AWC officer(s) to become familiar with existing data, tools and resources. See BEIS, *'Emissions of carbon dioxide for Local Authority Areas'* (online).[29]	Limited officer resource required	N/a – enabling action
D3	Proactively support decarbonisation of the national grid through planning policy	Provide support through planning policy for strategic energy infrastructure and LZC energy developments that support the national decarbonisation target.	Medium to long term	N/a – enabling action	As for planning policy in general, this relies on engagement with internal and external stakeholders including local community members. May require additional resource to raise awareness of the strategic importance of such schemes.	Officer resource required	N/a – enabling action
	Demand reduction						
R1	Produce an estate-wide carbon management plan	Develop an estate-wide carbon management plan that provides more	Short term	Critical for delivering the Carbon Neutral Plan An initial set of audits	AWC to produce carbon management plan	A further budget would be required to carry out additional audits, the cost of which will depend upon the nature and	High

[29] Available at: https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/emissions-of-carbon-dioxide-for-local-authority-areas

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
		granular detail and measures specific to each building that the Councils own or operate. This should be linked with any other maintenance / repair / replacement plans or any plans to purchase / lease additional buildings and must be kept up to date going forward.		have been carried out on selected buildings as part of this study to provide an insight into the potential intervention options. There is scope for more detailed investigations to be carried out on these buildings and for audits to be expanded to other buildings.		number of audits undertaken.	
R2	Undertake energy efficiency retrofits of all Council properties	Deliver the recommendations from the initial audits along with those from further audits and the estate-wide carbon management plan proposed in Action R1. To speed up delivery, this work should be co-ordinated with Actions H1, 2 & 3 for switching to heat pumps.	Short term (to review recommendations and begin planning) Medium to long term (further audits and retrofitting)	Critical for delivering the Carbon Neutral Plan	AWC to develop a programme for carrying out energy efficiency works identified in the carbon management plan and identify a suitable funding and delivery approach	The full costs of this cannot be estimated at this stage, due to the range of building types and uncertainty of the package of measures that would be required for each building. The full costs would be quantified as part of the estate-wide carbon management plan in Action R1.	High
R3	Instigate a behavioural change programme across all Council properties to reduce fuel consumption	A behaviour change programme should be initiated across the Councils' buildings and vehicle fleet to encourage staff to reduce fuel	Short term	Critical for delivering the Carbon Neutral Plan	AWC to instigate and support an ongoing behavioural change programme. Nominated staff will be required to drive the programme in each	This will require officer time to instigate and maintain, including a member of staff with overall responsibility and time for staff within each building.	High

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
		consumption. This could include e.g. switching off lights and heating systems when not in use, encouraging staff to carpool to work, etc.			office. Senior level involvement and support will be crucial.		
R4	Review BMS operation strategy	Currently the BMS at AWC occupied sites are accessed and programmed by third-party organisations. The set programs should be reviewed against current building operation patterns and updated accordingly. Where appropriate, control could be given to the building occupiers.	Short term	Highly effective where local control has been implemented (e.g. Worthing Leisure Centre). Where sites have dedicated facilities management personnel, local control will be highly effective at inexpensively and immediately reducing fuel consumption. Examples include the Town Hall (AWC operated) and Assembly Hall (tenant operated).	AWC to commission / undertake study	Budget required to commission a study (estimate £1-5K depending on scope) and provide officer resource.	High
R5	Link carbon reduction plans with existing maintenance and retainment strategies for Council-owned properties	Carry out a review to understand the retainment strategy, typology and age of buildings to inform more targeted interventions for projects, guidance and funding	Short to medium term	N/a – enabling action	AWC to commission / undertake study	Officer resources required	Medium-High
R6	Monitor results of energy efficiency programmes	Monitor the performance of energy efficiency	Medium to long term	N/a – enabling action to identify future interventions	AWC to monitor results	Officer resources required	Medium-Low

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
		programmes within AWC operations that are implemented as a result of any other actions in this Plan.					
R7	Business engagement and support, particularly for Small and Medium Enterprises (SMEs), related to energy efficiency for leased and tenanted properties	AWC could provide guidance to SMEs, in the form of forums, presentations, events, training or funding, to deliver energy efficiency improvements.	Medium term	Important for showing leadership within the community and potential to reduce Scope 3 emissions	AWC to develop and deliver training. Implementation relies on actions from businesses and other external stakeholders.	Budget required to provide this service as well as officer resource to establish and manage. Cost to AWC depends on the precise service offered but developing basic guidance materials and delivering training workshops could be £5-15K. However, if fuel consumption decreases there could be cost benefits either to AWC or their tenants / services.	Medium-Low
R8	Consider subsidised energy audits for leased and tenanted properties	AWC could consider providing subsidised energy audits to support SMEs in identifying energy improvement opportunities.	Medium term	Important for showing leadership within the community and potential to reduce Scope 3 emissions	Delivery will rely on actions of other parties (SMEs)	Budget required to provide this service as well as officer resource to establish and manage it. Cost to AWC depends on the precise service offered. Energy audits for a single building might range from £2-5K+, though this is heavily depending on size and complexity of the building and scope of the analysis.	Medium-Low
	Low carbon heat						

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
H1	Heating system replacement for Council owned buildings	Review heating system asset plan for Council owned buildings and identify opportunities for switching to heat pumps. Develop a programme for replacing existing gas boilers with efficient heat pumps. This should be combined with demand reduction measures outlined in Action R2.	Short to medium term (initiation) Medium to long term (delivery)	Modelling indicates that switching to heat pumps could potentially reduce the CO_2e emissions of each site by 20-80% by 2050, subject to electricity grid decarbonisation.	AWC to develop replacement programme	Officer resources required to develop heating replacement programme. Indicative costs of installing a heat pump are as follows: • £500-1000/kW for non-domestic buildings • £4-10k for domestic buildings Costs will depend on the type of system and level of additional infrastructure required, including electrical capacity reinforcements. For comparison, if replacing with a gas boiler: • £60-100/kW for non-domestic buildings • £1-2k for domestic buildings	Medium-High
H2	Investigate the potential for a low carbon heat network in and around the Worthing Civic Quarter / Worthing Town Centre	AWC to undertake a feasibility study to assess the technical feasibility and financial viability of delivering a heat-pump led heat network in and around the two identified sites.	Short term	CO_2e reduction depends on which buildings are connected. A heat network could offer higher reductions than individual systems with lower capital and operational costs.	AWC to commission / undertake study Feasibility study would identify practical barriers and other considerations to address going forward.	Budget required to commission an initial feasibility study and provide officer resource. HNDU subsidy is available for projects of this nature (funded by BEIS). This study will define the total capital costs, whole lifecycle financial and carbon benefits of delivering a heat network in this location.	Medium-High

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
H3	Investigate the potential for a low carbon heat network in and around the Shoreham Centre	AWC to undertake a feasibility study to assess the technical feasibility and financial viability of delivering a heat-pump led heat network in and around the identified site.	Short term	As for Action H2	As for Action H2	As for Action H2	Medium-High
H4	Explore opportunities for other heat networks	AWC to review other opportunities for heat networks	Medium to long term	A heat network could offer higher reductions than individual systems with lower capital and operational costs.	AWC to commission / undertake study	Good opportunity areas are those near a considerable heat source (i.e. Shoreham Power Station), public operated estate(s) and/or new development sites. Cost of undertaking a study into an identified opportunity area is as per Action H2.	Medium-High
	Building integrated renewable energy generation and storage						
E1	Identify further opportunities to install PV on Council buildings	AWC should build on previous experience and expand the installation of PV on the roofs of Council owned properties to support the roll out of heat pumps and EVs.	Medium to long term	Good carbon savings in the short term but will decrease as the grid decarbonises. Significant benefits in supporting operational costs and security of supply for Council buildings where heat pumps and EV charging	AWC has successful experience of PV installations. The financial viability of PV has been reduced by the removal of incentives from the Feed-in Tariff (FIT) scheme but increasingly PV installations are	Roof-mounted PV is likely to cost in the region of £750-1500/kW fully installed depending on scale and complexity of installation. Provides protection against electricity price rises. Opportunity for £0 CAPEX if delivered via Community	High

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
				points are installed.	becoming viable without incentives, particularly in combination with battery storage, EV charging and heat pumps.	Energy or energy as service model.	
E2	Identify opportunities to install PV on the roofs of Council-owned car parks	Investigate and (if feasible) install solar carport PV arrays on Council owned car parks.	Medium term (and ongoing whenever there is a change in building ownership, refurbishment, etc.)	Good carbon savings in the short term but will decrease as the grid decarbonises. Significant benefits in supporting wider EV rollout.	AWC are looking at this with the SLES project. Solar car parks are a technically proven solution with successful examples in Exeter, Cambridge and Nottingham.	Industry estimates suggest that roughly 2kW PV can be installed per car parking space and fully installed costs could be expected to be in the range of £900-1400/kW (per BRE Solar Car Park Guide)	High
E3	Investigate opportunities to install batteries in Council buildings	Monitor the viability of battery systems and assess the viability of including these in projects involving heat pump replacements, PV installations and/or EV charging points.	Medium to long term	Battery storage does not reduce carbon emissions per se but can improve the efficiency of other systems and reduce the reliance on the grid, saving both money and improving security of supply, both of which will be important as AWC moves to the use of heat pumps and EVs.	At current prices the installation of batteries is likely to make more commercial sense for larger projects. If a heat pump led heat network is delivered for the Civic Quarter or Shoreham Centre (Action H2), potentially along with PV and EV charging), this may be of sufficient scale to make a battery system viable.	Battery systems can be profitable where they combine the income from peak shaving, avoidance of use of service charges, arbitraging grid prices with time of use tariffs, frequency response contracts and additional value of PV and/or EVs.	Medium-Low

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
	Low carbon transport						
T1	Review AWC fleet and replacement plans	Conduct an audit of vehicle fleet to assess opportunities for renewal with zero emission alternatives	Short term	N/a – enabling action	Internal action (AWC)	Officer resources required	Medium-High
T2	Replace AWC car and van fleet with zero emission alternatives	Based on the audit carried out as part of Action T1, replace AWC vehicles with zero emission alternatives as these come up for replacement.	Medium term	Cars and vans represent around 5% of AWC's Scope 1 and 2 emissions, but the importance of this measure is also linked with the Councils taking a leadership role to encourage the wider uptake of EVs.	Internal action (AWC)	Depends on the technology in question and prices are likely to change significantly in the coming years. Currently EVs tend to be more expensive in whole lifecycle costs than conventional vehicles. This is primarily due to high capital costs and depreciation rates, although the running costs are lower. Note that the cost to drivers of using EV, hybrid and traditional fuel vehicles may converge in the coming decade.	High
T3	AWC to plan for future replacement of HGVs with zero emission alternatives	Replacement of the Council owned HGV fleet with low carbon alternatives will be needed to achieve the 2030 decarbonisation target and therefore should be accounted for in relevant plans and	Long term	Emissions from Council owned HGVs represent a large proportion (around 26%) of the Council's Scope 1 and 2 emissions.	This action relies upon the technology to become available and cost effective by the time the replacement is due – deliverability uncertain.	Costs will depend on technology readiness, the state of the LEV market and Government incentives at the time of investment.	High

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
		budgets.					
T4	AWC to install public charging infrastructure in its own estate	Help to support EV uptake through further provision of infrastructure within AWC's own estate. This would involve carrying out a review of existing car parks and parking spots, assessing the current and future level of demand for EV charging, and identifying locations that would be suitable based on the findings.	Short to medium term	Shows leadership in promoting sustainable transport and helps to overcome the 'chicken and egg' problem of EV uptake relying on available charging infrastructure. At present, the number of public EV charging points in the Local Authority area[30] is • Worthing: 10 public charging points (3 rapid) • Adur: 2 public charging points (0 rapid)	This should be coordinated with Action D1 (discussions with UKPN) to understand infrastructure capacity / constraints.	Budget required to commission a study of suitable locations and types (estimate £15-30K depending on scope). Indicative costs for different EV charging points[31] are as follows – • Slow (3.50-7kW): £500-1000 • Fast (7-22kW): £2,000-3,000 (AC) or £19,000 (DC) • Rapid (up to 50kW): £20K-40K Costs will depend on the level of additional infrastructure required, including electrical capacity reinforcements. There is a difference in cost when considering upfront installation compared with retrofitting. Per DfT estimates – • Typical domestic: £976 for upfront versus £2,040 for retrofitting • Typical non-domestic: £3,822 for upfront versus	Medium-High

[30] See http://maps.dft.gov.uk/ev-charging-map/
[31] Energy Saving Trust, *'Guide to chargepoint infrastructure for business users'* (2017). Available at: https://www.energysavingtrust.org.uk/sites/default/files/reports/6390%20EST%20A4%20Chargepoints%20guide_v10b.pdf

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
						£4,925 for retrofitting [32]	
T5	Reduce mileage of rental and owned fleet cars and other vehicles	This action should seek to address both vehicle movements (that is, finding ways to reduce the number of journeys required by the Councils) as well as user behaviours and choices. Review usage patterns, ensure efficiency of systems and bookings, routing and rounds. Encourage employees to use other modes for business meetings and facilitate ridesharing.	Short to medium term	Relatively low but necessary to mitigate the cost of shifting to ULEVs and mitigate pressure on grid infrastructure and fuel costs	WDC to explore options for reducing mileage. Requires effective internal communication.	Moderate officer resources required to plan and deliver this measure. Potential cost savings due to lower demand for fuel, maintenance, etc.	Medium-High
T6	Reduce emissions from owned and rented vehicles by introducing minimum performance requirements (CO_2/mile)	Undertake review of good practice and case studies in other organisations. Explore incentivising through different mileage payment rates.	Short to medium term	CO_2 saving not assessed but this would help to enable a reduction in transport emissions	Requires effective internal communication and engagement with finance/payroll/HR.	Limited officer resources required. The higher capital cost of ULEVs may increase costs for the Councils, but this could be offset in part through higher payments for more polluting vehicles and lower running costs for ULEVs.	Medium-Low

[32] Department for Transport, *'Industrial Strategy: Electric Vehicle Charging in Residential and Non-Residential Buildings'* (July 2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/818810/electric-vehicle-charging-in-residential-and-non-residential-buildings.pdf

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
T7	Reduce emissions from HGVs where possible	Aim to achieve a 15% reduction in CO_2 emissions from HGVs through measures such as smart route planning and driver training.	Short to medium term	A 15% reduction would lower the Councils' total Scope 1 and 2 emissions by around 4%. (The target is based on industry-wide aspirational targets for lowering HGV emissions, under the assumption that ULEV HGVs will not be widely available.)	AWC to undertake review of best practice measures implemented in other organisations and develop implementation strategy	Level of investment depends on the measures selected for implementation.	Medium-Low
	Offsetting						
O1	Undertake an assessment of opportunities for offsetting residual CO_2e emissions	AWC to commission a study to review specific project opportunities for delivering carbon savings through investment in renewables or other projects, both within and outside of the Local Authority area, including a review of costs and benefits. Opportunities could include e.g. investing in large-scale PV or wind generation, woodland creation,	Medium term	Potentially high impact, but note that energy demand reduction measures, and reducing the use of fossil fuels are a higher priority than carbon offsetting.	AWC to commission / undertake study	Budget required to commission a study (estimate £10-30K depending on scope) plus officer resources. Estimates of potential delivery costs are provided below, based on published figures. [33] • Solar farms – Cost in the UK can be around £1,000,000 per MW. A 5 MW solar farm may occupy around 25 acres of land.[34] • Large-scale wind – Cost of onshore wind can be around £1,000,000 per MW. A large turbine of 1.5	Medium-Low

[33] International Renewable Energy Agency, *'Renewable Power Generation Costs in 2018'* (2018). Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/May/IRENA_Renewable-Power-Generations-Costs-in-2018.pdf

[34] According to the UK Solar Trade Association: https://www.solar-trade.org.uk/solar-farms/

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
		etc.				MW might be 70-120m in height. Note that costs have decreased significantly in recent years and, in future, may vary widely depending on UK Government policy initiatives, funding, etc. AWCAWC	
O2	AWC to consult on the options for delivering offsite CO_2e emissions savings	Based on the results of this studies and the other studies recommended above, AWC should discuss the 'offset' options internally to agree on an approach that would be most acceptable, taking account of the measure and location.	Medium term	N/a – enabling action	Internal action (AWC)	Officer resources required.	Medium-Low
	Scope 3 Emissions						
S1	Work with suppliers to provide better emissions data	In order for the Council to better understand its Scope 3 emissions further information will be required from its suppliers in relation to the CO_2e emissions	Short term	N/a – enabling action	Internal action (AWC) but requiring the support of suppliers	No additional costs are envisaged for this, but officer resources will be required to engage with suppliers.	High

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
		associated with the services being procured by AWC. This requirement needs to be discussed with existing suppliers and built into all new contracts.					
S2	Reduce waste production in Council offices	AWC to review existing waste streams, identify relevant opportunities and guidance related to waste reduction and implement appropriate measures.	Short term	Although the CO_2e emissions associated with waste generated by the council have not yet been quantified, any measures to reduce waste generation and waste sent to landfill will have a positive environmental impact	Internal action (AWC)	Officer time to review existing waste streams and identify suitable measures to promote waste reduction and recycling.	Medium-Low
S3	Reduce water consumption in AWC offices	AWC to reduce water consumption in buildings through the use of low water use toilets, flow restrictors on taps and showers and leak detection systems. Grey/rain water systems could also be investigated.	Medium term	Potentially low-medium in terms of CO_2e emissions reduction but offers other environmental and cost benefits due to conservation of water resources	AWC to develop rollout programme for easy win measures and specify low water-use fittings as part of any refurbishment programmes	Minimal costs for flow restrictors and if sanitaryware is part of planned replacement works. Grey/rainwater systems would have higher costs.	Medium-High
S4	Low carbon heating systems in Council leased properties and / or properties owned by	Undertake a review of the buildings Council leased properties and / or	Short term	See previous notes on the benefits of low carbon heating systems.	AWC to undertake assessment.	Officer resources required to develop heating replacement programme.	Medium-Low

Ref	Action	Description	Timeframe	Effectiveness	Deliverability / roles	Investment / resource implications	Priority
	the Council but leased by other organisations	properties owned by the Council but leased by other organisations to identify whether there are opportunities for installing low carbon heating systems.		Decarbonising heat will be crucial to achieving the decarbonisation target.	Deliverability depends on the specific contracting / tenancy arrangements for the building(s) in question.	As per costs above.	
S5	Support waste reduction and water conservation measures in leased and tenanted properties	AWC to identify and keep informed of waste reduction and water conservation initiatives and actively seek out opportunities to engage / promote these schemes on an ongoing basis	Short term	As above, measures that the Council can take to promote waste minimisation, good reuse, recycling and composting practices, water efficiency, and potentially rainwater harvesting, or greywater recycling.	AWC and waste contractors	Officer time to promote waste reduction and recycling	Medium-Low

4.2 Measuring progress

Monitoring and review

We recommend that the Councils set up a monitoring and review process to assess progress against the CO_2e emission projections and other targets. This could be done on an annual basis or, to align with the Committee on Climate Change's national carbon budgets, be split into 5-year periods.

Quarterly:

- Monitor progress against the Carbon Neutral Plan
- Report to members and partners

Annually:

- Report progress to internal and external audiences
- Monitor renewable energy generation and installed capacity
- Monitoring of the cost benefits achieved (for instance, by estimating the energy savings that are achieved and the costs avoided as a result)

In addition to reporting on the steps taken to achieve specific actions, the priorities of this Carbon Neutral Plan should be reviewed on an annual basis. This review should account for broader factors such as policy or technological changes; where appropriate, the Carbon Neutral Plan should be updated to reflect such changes.

Assessment metrics

In addition to annual CO_2e emissions, other metrics can be used to monitor positive enabling steps taken by Adur & Worthing Councils. Some examples are provided in the table below, which could be used to set additional quantitative targets.

	Topic	Method
1	Deployment of low carbon heating systems (heat pumps and heat networks) in Council-owned properties	Councils to maintain internal records
2	ULEV vehicles in the Council-owned fleet / pool cars (number of vehicles and % of total journeys or distance travelled)	Councils to maintain internal records
3	Improvement in energy efficiency of Council-owned buildings as a result of improvement works	EPC and DEC records or other surveys
4	Capacity of LZC energy technologies installed by the Council (MW)	Councils to maintain internal records
5	Amount of renewable heat or electricity generated by LZC energy technologies, used onsite and / or exported (MWh p.a.)	Councils to maintain internal records
6	EV charging points owned / operated by the Council (number, type, location)	Councils to maintain internal records
7	Deployment of smart meters within Council-owned properties (number and % of total properties)	Councils to maintain internal records
8	Assessment of the progress of national electricity grid decarbonisation	Carbon factors are published annually by BEIS
9	Any other CO_2e offsetting e.g. areas of woodland created, trees planted, PPAs or carbon reduction certification achieved	Councils to maintain internal records

5. Conclusion

5.1 Recommendations

The measures and actions described in this Carbon Neutral Plan reflect the following overarching recommendations:

- Adur & Worthing Councils should take a leadership role in reducing CO_2e emissions by examining their own operations, buildings, vehicle fleet, services and investments and identifying best practice measures that can be implemented.
- The Councils should recognise that demand reduction, fuel switching and LZC energy generation are top priorities. However, given that some carbon offsetting will inevitably be required to meet the decarbonisation target, the Councils should immediately start carrying out further research to understand the offsetting opportunities that might be available.

Some of the actions laid out in this Plan will rely on broader trends that are outside of the Councils' control. Therefore:

- The Councils should proactively support other Local Authorities and organisations in delivering the actions required to reach net zero carbon. The SLES SMARTHUBS project is an example of an opportunity for the Councils to exert indirect influence in this regard.
- The Councils should take steps to lobby the Government to achieve more rapid and deeper carbon reductions across key priority areas, including higher energy efficiency standards for new and existing buildings, policies that support uptake of renewable and low carbon technologies, and the development of low carbon transport and infrastructure.
- The Councils should proactively support such measures through their own planning policy and decisions. In particular, the Councils should take a proactive and positive attitude towards increasing the amount of local LZC energy generation as an important means of 'doing their part' on national electricity grid decarbonisation. Similarly, they should seek to facilitate ULEV uptake wherever possible.

5.2 Next steps

Based on the findings of this report, we propose the following immediate next steps:

- Disseminate findings of this report and carry out further consultation to review and approve the Carbon Neutral Plan.
- Begin the process of reaching out to stakeholders, including local authorities, LEPs, utility companies (e.g. UKPN, Southern Gas), government departments / agencies (e.g. Department for Transport, Department of Environment, Food and Rural Affairs, and the Forestry Commission), and others (e.g. WRAP) to identify opportunities for collaboration and engagement.
- Review any ongoing or near future projects that are relevant to the measures listed in the Carbon Neutral Plan to ensure that activities are well-coordinated and integrated. This would include, for instance, plans for redeveloping the Civic Quarter, plans to reduce vehicle mileage in waste collection routes, and plans to refurbish or replace existing buildings, in addition to the Council's general strategies for building management or fleet replacement.

5.3 A final note

The results of this analysis show that the route towards becoming carbon neutral will require a strong level of ambition and commitment, backed up by significant interventions and investment across Adur & Worthing Councils' operations. Although the study shows that meeting the carbon neutral ambition will rely upon some factors outside of the Councils' control, such as the decarbonisation of the grid and availability of key technology, the fundamental steps required to deliver the net-zero target are clear and with strong leadership from the Councils these can be set into action now.

Appendix A – Modelling methodology

A.1 Data sources

The table below summarises the data used in establishing Adur & Worthing Councils' baseline CO_2e emissions.

Category	Description	Data used in this analysis
Scope 1	Direct emissions from sources owned or controlled by the reporting organisation	Metered gas data (for buildings where the Councils pay the gas bills) (kWh and £) Mileage for Council-owned vehicle fleet and pool cars, along with vehicle make/model and age
Scope 2	Indirect emissions from the generation of energy purchased by the reporting organisation	Metered electricity data (for buildings where the Councils pay the electricity bills) (kWh and £) *Note that, where data was unavailable, CIBSE Guide F 2012 'typical practice' benchmarks for 'local government office' have been used to estimate fuel consumption.*
Scope 3	Indirect emissions that result from other activities that occur in the value chain of the reporting organisation, either upstream or downstream.	Metered water use data (m^3) Records of business travel by the Councils' employees (cost data provided; mileage estimated from £/mi)

Although a sense-checking exercise was carried out to ensure the completeness and accuracy of the data provided by Adur & Worthing Councils, AECOM accepts no responsibility for any errors or omissions therein.

A.2 Baseline carbon emissions

General approach

The carbon emissions baseline was estimated in compliance with the methodology and conversion factors for greenhouse gas emissions reporting published by BEIS in 2019.

CO_2e figures for different fuel types and activities were taken from the BEIS *'Green Book Supplementary Guidance: Toolkit for valuing changes in greenhouse gas emissions, Table 1'* (2019). These include figures for CO_2e emissions from:

- Use of natural gas ($kgCO_2e$ / kWh)
- Use of UK grid electricity ($kgCO_2e$ / kWh)
- Distance travelled (figures are provided for various different vehicle types) ($kgCO_2e$ / km)
- Water consumption (kg CO_2e / m^3)

Figures for electricity and gas consumption (kWh), vehicle mileage (km) and water consumption (m^3) were multiplied by these CO_2e figures to obtain an estimate of the total emissions from each category.

Estimating vehicle mileage

Adur & Worthing councils provided AECOM with a dataset of vehicles which included the total mileage, the fuel type, the year of manufacture and the registration number of each vehicle.

In order to estimate emissions from the Councils' vehicle fleet, average yearly mileage figures were calculated based on the total mileage and the years in service for each vehicle. Then, the annual carbon emission figures for vehicles up to 3.5 t were estimated based on the fuel type, revenue

weight (obtained from gov.uk MOT database[35] using registration numbers) and the corresponding CO_2e figures provided by the BEIS under Scope 1. The same procedure was followed for the heavier vehicles using the average laden values provided by BEIS.

In order to estimate emissions from pool car usage, a similar approach was taken. The council provided a dataset which included fuel types, trip distances and registration numbers of all the vehicles hired. The emissions were estimated based on the fuel type, trip distances, the engine size (also obtained from the gov.uk MOT database) and the corresponding CO_2e figures provided by the BEIS under Scope 3 ('business travel'); however, these are included in Scope 1 in this report because Adur & Worthing Councils control the operation these vehicles.

A.3 Carbon emission projections

The carbon emissions projections are carried out based on the following key assumptions.

Grid decarbonisation pathway

Carbon emission factors (CEFs) for electricity were taken from HM Treasury/BEIS *'Green Book Supplementary Guidance: Toolkit for valuing changes in greenhouse gas emissions, Table 1'* (2019) which is intended for use by organisations reporting on their greenhouse gas emissions. Note that this trajectory reflects the level of decarbonisation that would be necessary for the UK to meet its current decarbonisation targets. It is not a projection of the likely emissions from grid electricity.

Electricity demand reduction

Evidence suggests that reductions of around 5% can be achieved through measures such as behavioural changes, smart metering, and zone lighting. Case studies suggest that greater reductions are possible for some organisations. However, in recognition of the fact that electricity use has increased in the past decade due to factors such as increasing use of electronic appliances, 5% has been used as a conservative estimate.

The model assumes that total electricity consumption will decrease linearly through the year 2030, at which point this reduction will be achieved.

Heating demand reduction from energy efficiency measures

Evidence from the National Energy Efficiency Database (NEED) indicates that installing multiple energy saving measures (such as cavity wall or loft insulation) can reduce heating bills by around 10%. From a technical standpoint, higher savings (over 75% in some properties) could be achieved with more ambitious retrofitting strategies,[36] so this assumption has been used as a conservative estimate.

This would not necessarily require all buildings to undergo a retrofit – it represents an average across the entire stock. In other words, some buildings could be retrofitted to a higher standard, while others (such as Listed buildings) receive no upgrades.

The model assumes that total gas consumption will decrease linearly through the year 2030, at which point this reduction will be achieved.

Impact of fuel switching

This calculation assumes that the metered gas consumption is delivered by individual gas boilers (80% efficiency). The total metered gas consumption data is used to provide a rough estimate of the amount of electricity that would be required if this level of demand was instead met using direct electric heating (100% efficiency) or heat pumps (COP of 2.5, which is intended as a conservative estimate that reflects the performance of air source heat pumps in situ).

It is assumed that the Crematorium will also switch to an electric system offering similar performance levels (see energy audit report for further details).

[35] https://vehicleenquiry.service.gov.uk/ViewVehicle
[36] https://passipedia.org/certification/enerphit

The model assumes that 90% of Council-owned buildings will switch to an electric heating system by 2030. This would require an ambitious programme of heating system replacement with significant cost implications. Therefore, the calculation also assumes that 50% of the new heating systems will be DEH and 50% will be ASHP as an illustrative scenario, in recognition of the fact that DEH may be cheaper and more practical to install. Additional carbon reductions could potentially be achieved if more systems were replaced with ASHPs.

The model assumes that gas heating systems will be replaced with electric heating systems at a consistent rate (i.e. linearly) to 2030.

Vehicle mileage reduction

According to the *'Road to Zero'* report: *'Evidence from 60,000 fleet drivers receiving training through the Energy Saving Trust (EST), a key partner supporting the efficient motoring agenda, gave an average 15% saving of fuel and CO_2 […] Organisations that have incorporated a wider package of behavioural and procedural measures in managing their fleets […] have delivered typical emission savings of between 10-30%.'*

In this report we have assumed a 10% reduction in mileage is possible across the organisation, based on case study evidence,[37] and that emissions from HGVs could decrease by up to15%.

The model assumes that a 10% reduction in either journeys, vehicles, or miles travelled will result in a 10% reduction in CO_2e emissions from those vehicles. In reality, a travel strategy aimed at reducing emissions would likely seek to target certain types of trips, vehicles, or users, so this approach should be understood as a rough estimate. However, for the purpose of this analysis, it is considered sufficient to show a simple proportional reduction to highlight the relative scale of impact such a measure could have, relative to other interventions.

Impact of switching to ULEVs

Based on the estimated mileage for each vehicle type, we have re-calculated CO_2e emissions using BEIS Green Guide figures for electric vehicles.

Carbon savings from LZC energy generation

Carbon savings from LZC energy generation are based on the amount of national grid electricity that would be offset by renewable electricity.

The user inputs a total figure for the amount of LZC capacity that will be installed by 2030, and the model assumes that the total savings increase linearly up to that point.

An estimate is then made of the potential amount of renewable electricity that could be generated by those technologies (large-scale PV or wind). The electricity generation figure is multiplied by the CEF for a given year to provide an estimate of the total CO_2e savings in a given year.

- *Large-scale PV:* Assumed output of 800 kWh/kWp based on typical performance in the UK
- *Large-scale onshore wind:* Capacity factor based on renewable energy capacity and generation figures for Adur and Worthing, per BEIS, *'Renewable energy by Local Authority'* (2019)

Note that, as the electricity grid decarbonises, more LZC energy generation is required to offset any residual emissions. Therefore, although the amount of LZC capacity is assumed to increase linearly, the savings per MW decrease as time goes on.

Carbon reductions from woodland creation and tree planting

Based on nation-wide statistics from the Woodland Carbon Code, new woodlands created from low-grade agricultural land have the potential to sequester around 356 tCO_2e per hectare over 100 years, or 3.56 tCO_2e per hectare per year on average.

[37] Department for Transport and Energy Savings Trust, *'Mileage Management – A Guide for Fleet Managers'* (2015). Available at: https://www.energysavingtrust.org.uk/sites/default/files/reports/4548_EST_A4_mileage_mmt_4.pdf

It is assumed that the amount of new woodland increases linearly to 2030. Based on user inputs for the number of hectares planted, the model calculates the total potential carbon reduction potential. This is subtracted from the total estimated carbon emissions following adoption of all intervention measures, after accounting for renewable energy generation.

A.4 References

BEIS, *'Emissions reduction pledge 2020: Emissions reporting in public and higher education sectors'* (2018). Available at: https://www.gov.uk/government/publications/emissions-reduction-pledge-2020-emissions-reporting-in-public-and-higher-education-sectors

BEIS, *'Green Book Supplementary Guidance: Toolkit for valuing changes in greenhouse gas emissions, Table 1'* (2019). Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

BEIS, *'Greenhouse gas reporting: Conversion factors 2019'* (2019). Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019

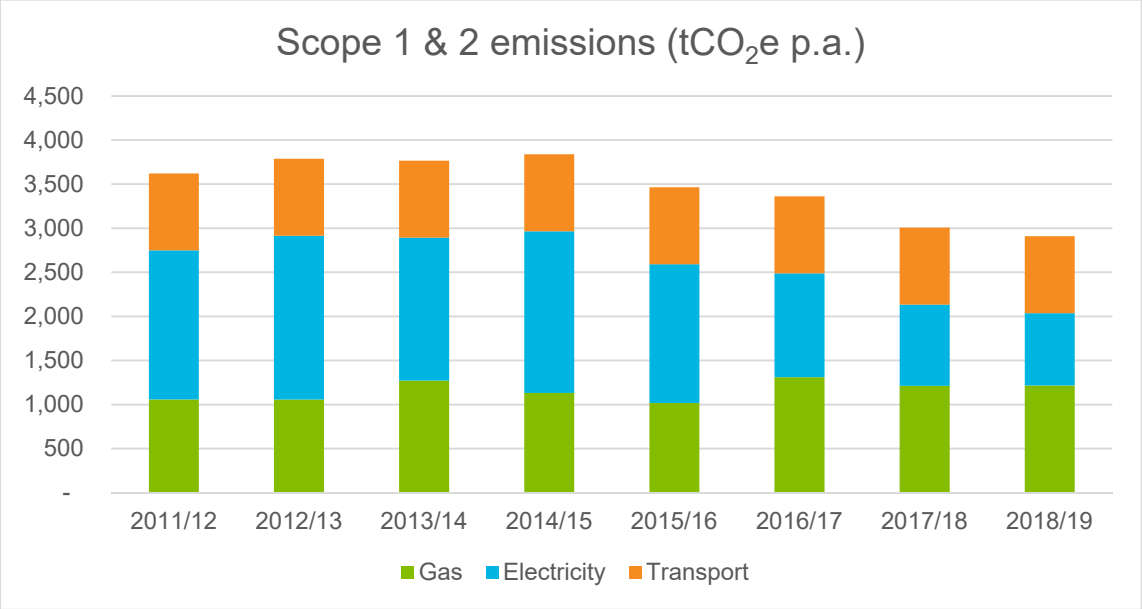
BEIS, '*Renewable energy by Local Authority'* (2019). Available at: https://www.gov.uk/government/statistics/regional-renewable-statistics

Forestry Commission, *'Woodland Carbon Code Projects in the UK at 31 March 2019'* (published June 2019). Available at: https://data.gov.uk/dataset/058df59a-bb57-4959-8a39-2dc35b0d894f/forestry-statistics-woodland-carbon-code-statistics

NEED, *'Summary of Analysis, Great Britain'* (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/812561/National_Energy_Efficiency_Data_Framework__NEED__report_summary_of_analysis_2019.pdf

Appendix B – Historic Scope 1 & 2 emissions for Adur & Worthing Councils

Scope 1 & 2 emissions for the financial years 2011/12 through 2018/19 are presented below, based on the data and methodology as described in Appendix A.



Details are provided in the table below.

		Emissions (tCO_2e)							
Category	**Fuel**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**2018/19**
Non-Residential	Elec	894	982	1,005	922	820	598	491	484
	Gas	388	388	440	405	387	415	465	422
Residential	Elec	133	147	230	199	161	114	90	75
	Gas	415	415	409	359	354	350	369	346
External	Elec	576	633	277	619	511	400	284	205
Crematorium	Elec	88	97	110	94	83	67	58	57
	Gas	254	254	422	368	276	546	377	448
All categories	Elec	1,057	1,057	1,271	1,132	1,017	1,310	1,212	1,215
All categories	Gas	1,692	1,859	1,622	1,834	1,575	1,178	923	820
Transport	All	873	873	873	873	873	873	873	873
TOTAL Scope 1 & 2	**All**	**3,621**	**3,788**	**3,766**	**3,838**	**3,464**	**3,361**	**3,007**	**2,908**
Scope 3 emissions – Business travel (essential and casual user mileage) and water consumption only									
Business travel	All	*Estimated average 33 t CO_2e per year*							
Water	All	-	-	-	-	-	-	28	33

Appendix C – Recommendations from the energy audits carried out to date

In order to identify specific opportunities for demand reduction measures in the Councils' own buildings, AECOM carried out building energy audits on a range of properties owned and operated by Adur & Worthing Councils. The following tables summarise energy conservation measures (ECMs) identified for each of these properties and suggest potential timelines for implementation.

Acronyms	Name
AMR	Automatic Meter Reading
BMS	Building Management System
CCL	Climate Change Levy
CCHP	Combined Cooling, Heat & Power
CHP	Combined Heat & Power
DHW	Domestic Hot Water
DX	Direct Expansion
ECM	Energy Conservation Measure
HVAC	Heating, Ventilation & Air Conditioning
kWh	Kilo-Watt Hour
LED	Light Emitting Diode
LPHW	Low Pressure Hot Water
LZC	Low Zero Carbon
MWh	Mega-Watt Hour
M^3	Cubic Meters
SC	Space Cooling
SH	Space Heating
VRV	Variable Refrigerant Volume
VSD	Variable Speed Drive
FY	Financial Year

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Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

Where field investigations are carried out, these have been restricted to a level of detail required to meet the stated objectives of the services. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in issuing this Report.

Costs may vary outside the ranges quoted. Whilst cost estimates are provided for individual issues in this Report these are based upon information at the time which can be incomplete. Cost estimates for such issues may therefore vary from those provided. Where costs are supplied, these estimates should be considered in aggregate only. No reliance should be made in relation to any division of aggregate costs, including in relation to any issue, site or other subdivision.

No allowance has been made for changes in prices or exchange rates or changes in any other conditions which may result in price fluctuations in the future. Where assessments of works or costs necessary to achieve compliance have been made, these are based upon measures which, in AECOM's experience, could normally be negotiated with the relevant authorities under present legislation and enforcement practice, assuming a pro-active and reasonable approach by site management.

Forecast cost estimates do not include such costs associated with any negotiations, appeals or other non-technical actions associated with the agreement on measures to meet the requirements of the authorities, nor are potential business loss and interruption costs considered that may be incurred as part of any technical measures.

C.1 Worthing Town Hall

#	Measure	Potential implementation timeline	Estimated economic impact
1i	Boiler plant replacement with ASHP	Medium / long term, high impact works	Additional 20-year WLC cost of £34 per tonne CO_2
1ii	Boiler plant replacement	Medium term, medium impact works	Payback 17 years
2	Secondary glazing	Short term, low impact works	Payback 12 years
3	Linking of room booking systems to BMS	Short term, low impact works	Not quantified
4	Review of BMS temperature set points	Immediate, medium impact works	Instant
3	Rainwater harvesting	Short term, low impact works	Not quantified

C.2 Portland House

#	Measure	Potential implementation timeline	Estimated economic impact
1i	Boiler plant replacement with ASHP	Medium / long term, high impact works	Additional 20-year WLC cost of £207 per tonne CO_2
1ii	Boiler plant replacement	Medium term, medium impact works	Payback 32 years
3	Resealing of the double-glazed windows	Short term, low impact works	Unknown
4	Investigate the variable electrical baseload	n/a	n/a

C.3 Sheltered housing

Note that surveys were conducted at three of the Councils' sheltered housing schemes. Results for all properties are summarised below.

#	Measure	Potential implementation timeline	Estimated economic impact
1.i	Replace boilers with ASHPs	Medium / long term, high impact works	Additional 20-year WLC cost of £32 per tonne CO_2
1.ii	Replace boilers with GSHPs	Medium / long term, high impact works	Payback 10 years

2	Improve control systems	Short term, low impact works	Payback 2 years
3	Replacement boilers	Medium term, medium impact works	Payback 8.2 years
4	Plantroom insulation (Ashcroft)	Short term, low impact works	Payback in 2 years

C.4 Multi storey car parks (MSCPs)

#	Measure	Potential implementation timeline	Estimated economic impact
1	Roof mounted PV panels	Medium term, medium impact works	9.8-16.4 years

C.5 Crematorium

ECM#	ECM	Potential implementation timeline	Estimated economic impact
1	Conversion of gas-fired cremators to induction	Long term, high impact	Not quantified
2	PV installation in car park	Medium term, medium impact	Payback in 7.01 years
3	Capture of waste heat for external use	Long term, high impact	Not quantified
4	Overdoor heating curtains	Short term, small impact	Payback in max. 12.7 years

C.6 Shoreham Centre

#	Measure	Potential implementation timeline	Estimated economic impact
1i	Boiler plant replacement with ASHP	Medium / long term, high impact works	Extra £200/tonne $C0_2$ saved
1ii	Boiler plant replacement with GSHP	Medium / long term, high impact works	Extra £76/tonne $C0_2$ saved.
2	VSDs on old space heating circuit	Short term, small impact works	10-year payback
3	Timer control on bar bottle fridges	Short term, small impact works	Maximum 2.5-year payback
4	Reduction in level of cooling in server room	Instant change	Instant payback

5	Automation of temperature control (old part of building)	n/a	n/a
6	HVAC zonal control linked to room booking system	n/a	n/a
7	Rainwater harvesting	n/a	n/a

C.7 Commerce Way

#	Measure	Potential implementation timeline	Estimated economic impact
1i	Office Boiler plant replacement with ASHP	Medium / long term, high impact works	Additional 20-year WLC cost of £344 per tonne CO_2.
1ii	Office Boiler plant replacement with GSHP	Medium / long term, high impact works	Additional 20-year WLC cost of £309 per tonne CO_2.
2	Workshop gas heaters replaced with infrared spot heaters	Short term, high impact works	Payback in 10 years
3	Workshop internal lighting system replaced with LED	Short term, medium impact works	Payback in 1.5 years
4	PV over vehicle parking areas	Long term, medium impact works	Payback in 10.1 to 17.6 years
5	Office area loft insulation	Short term, medium impact works	Payback in 5 years
6	Office Window replacement	Short term, medium impact works	Not quantified
7	Level of heating in unused portion of building	Instant	Instant
8	Server room cooling level	Instant	Instant

C.8 Assembly Hall

#	Measure	Potential implementation timeline	Estimated economic impact
1	BMS strategy review	Short term, high impact works	Immediate payback
2	Boiler plant replacement	Medium / long term, high impact works	Refer to Town Hall survey report
3	Stage lighting replacement	Medium term, small impact works	Payback 0.5 years
4	Secondary glazing	Short term, low impact works	Payback 3.8 – 7 years
5	Rainwater harvesting	Short term, low impact works	Not quantified

C.9 Worthing Museum

#	Measure	Potential implementation timeline	Estimated economic impact
1	HVAC and BMS review	During upcoming redevelopment	Not quantified
2	Secondary glazing	During upcoming redevelopment	Payback in 8.8-15 years
3	Rainwater harvesting	During upcoming redevelopment	Not quantified

C.10 Worthing Leisure Centre

#	Measure	Potential implementation timeline	Estimated economic impact
1i	Boiler plant replacement with ASHPs	Medium / long term, high impact works	Additional 20-year WLC cost of £234 per tonne CO_2.
1ii	Boiler plant replacement with GSHPs	Medium / long term, high impact works	Additional 20-year WLC cost of £52 per tonne CO_2.
3	Photo voltaic panels	Medium term, high impact works	Payback in 8.9 to 12.3 years
2	Grey water heat recovery	Short term, small impact works	Not quantified
4	Rainwater harvesting	Medium term, small impact works	Not quantified
5	Ventilation heat recovery	Medium term, small impact works	Not quantified